ST012 Remedial Action
Field Variance Memorandum #4 – Additional Site Characterization

Date: 29 September 2016

From: Amec Foster Wheeler Environment & Infrastructure, Inc.

To: Catherine Jerrard (AFCEC)

Cc: Geoff Watkin (CNTS)

Subject: **Proposed Drilling Work Plan for Additional Site Characterization**
Former Liquid Fuels Storage Area (ST012)
Former Williams Air Force Base – Mesa, Arizona

1.0 INTRODUCTION

This Field Variance Memorandum (Memo), prepared as a variance to Draft Final Addendum 2 to the Remedial Design and Remedial Action Work Plan (RD/RAWP) (Addendum 2) (Amec Foster Wheeler, 2016), describes additional characterization of the extent of aviation gasoline (AVGAS) and jet petroleum grade 4 (JP-4) contaminated soil and groundwater at the Former Liquid Fuels Storage Area (ST012) at the former Williams Air Force Base. The data supporting this Memo are compiled from preliminary soil and groundwater characterization results from the Phase 1 investigation at ST012 conducted in accordance with Addendum 2 (Amec Foster Wheeler, 2016). Data summaries and evaluations of Phase 1 results were presented in the 24 August 2016 BCT meeting (ST012 slides provided in **Attachment 1**). Data supporting the results are also presented in the ST012 weekly reports, draft boring logs from the Phase 1 investigation, and analytical data provided via the project SharePoint site. An evaluation of the additional stated regulatory concerns identified during the 24 August 2016 BRAC Cleanup Team (BCT) meeting has been included as **Attachment 2**. Resulting proposed soil boring and monitoring well locations are shown in Figure 1, included as **Attachment 3**. Lastly, the rationale and drilling plan for each proposed soil boring or monitoring well location is included as **Attachment 4**. Attachments 2, 3, and 4 were presented and discussed on the 15 September 2016 BCT conference call.

2.0 OBJECTIVES

As discussed during the 24 August 2016 BCT meeting, the objectives for the drilling and installation of new soil boring and monitoring well locations at ST012 are as follows:

- To expand characterization of the extent of light non-aqueous phase liquid (LNAPL) in soil outside of the former steam enhanced extraction (SEE) thermal treatment zone (TTZ) for the cobble zone (CZ), upper water bearing zone (UWBZ), and lower saturated zone (LSZ) by bounding known LNAPL-containing soils with soil cores that do not indicate LNAPL presence.
- To expand characterization of the extent of dissolved concentrations outside of the SEE TTZ for the CZ, UWBZ, and LSZ that exceed the cleanup criteria.

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- To re-analyze the estimated LNAPL mass remaining to help inform future remedial decisions.

The basis for the proposed investigation locations was presented at the 24 August 2016 BCT meeting (see **Attachment 1**). An evaluation of potential locations identified during the 24 August 2016 BCT meeting and proposed modifications are included as **Attachment 2**. These modifications have been incorporated into the scope presented in this Memo.

3.0 SCOPE OF WORK

Table 1 below provides investigation location identification, investigation type, and proposed screened intervals and surface finish for the monitoring wells. A plan view of proposed soil boring and monitoring well locations is included in **Attachment 3**.

Table 1 Proposed Monitoring Wells and Soil Borings

Location Identification	Location Type	Screened Interval (ft bgs)[2]	Depth (ft bgs)	Surface Finish
Soil Boring and Single Screen Well Locations				
ST012-SB16	Soil Boring	--	195	--
ST012-SB17	Soil Boring	--	230	--
ST012-SB18	Soil Boring	--	230	--
ST012-SB19	Soil Boring	--	230	--
ST012-CZ23[1]	Monitoring	145-160	195[3]	Flush Mount
ST012-CZ25	Monitoring	145-160	160	Flush Mount
ST012-CZ26[1]	Monitoring	145-160	160	Flush Mount
ST012-UWBZ40	Monitoring	175-195	195	Flush Mount
ST012-LSZ54	Monitoring	205-230	230	Flush Mount
ST012-LSZ56	Monitoring	205-230	230	Flush Mount
ST012-LSZ57	Monitoring	205-230	230	Flush Mount
ST012-LSZ58	Monitoring	205-230	230	Flush Mount
ST012-LSZ60[1]	Monitoring	205-230	230	Flush Mount
Three Proximate Well Locations (one location)				
ST012-CZ24	Monitoring	145-160	160	Flush Mount
ST012-UWBZ38	Monitoring	175-195	195	Flush Mount
ST012-LSZ55	Monitoring	205-230	230	Flush Mount
Two Proximate Well Locations (two locations)				
ST012-UWBZ37	Monitoring	175-195	195	Flush Mount
ST012-LSZ53	Monitoring	205-230	230	Flush Mount
ST012-UWBZ39	Monitoring	175-195	195	Flush Mount
ST012-LSZ59	Monitoring	205-230	230	Flush Mount

Notes:
ft bgs – feet below ground surface
[1]Contingent on further groundwater sample results

[2]Screened interval subject to change based on observed geology.
[3]Location will be drilled to 195 ft bgs for LNAPL characterization. The installed well, if necessary, is for dissolved phase characterization in the cobble zone only.

The required method for drilling of these wells is using sonic drilling techniques with the exception that alternate drilling techniques will be allowed for adjacent shallower wells that have a collocated deeper boring/well. Both soil borings to test for LNAPL and soil borings to be completed with monitoring wells are included in this work. Three depths will be drilled: CZ (to 160 feet), UWBZ (to 185-195 feet), and LSZ (to 205-230 feet). The total number of borings and single screen well locations to be installed is four and nine, respectively.

In addition to the single screen locations, there are three proposed monitoring well locations that have either two or three monitoring wells for varying depths in the same proximate location. During the procurement process, the method for installing these monitoring wells will be chosen by Amec Foster Wheeler, based on methods proposed by drilling contractors based on specified minimum requirements and on the drilling contractor's experience. The methods may include individual adjacent borings for the proximate wells nested well installation, or a combination the two (e.g., a two-well nest plus an adjacent single well). Three-inch diameter wells will be allowed for nested well construction. Otherwise, all wells will be constructed to be 4-inches in diameter.

Although steam injection occurred at the site in the recent past, the proposed wells for this project are all in perimeter locations and are anticipated to be outside of the higher subsurface temperature region of the site. As a result, polyvinyl chloride (PVC) construction materials are anticipated to be adequate.

Wells will be drilled and constructed in accordance with Standard Operating Procedures (SOPs) 4 and 6, as included in the RD/RAWP (AMEC, 2014). A drilling plan has been identified for each proposed boring/well and is included as **Attachment 4**. The drilling plan includes protocols at each location for evaluation of LNAPL extent and dissolved phase extent as it relates to potential additional step out borings.

Following drilling activities, well development will be performed in accordance with SOP 7B provided in Appendix H of the Draft Final Addendum 2 to the RD/RAWP (Amec Foster Wheeler, 2016).

4.0 PERFORMANCE MONITORING

All well cores will be screened with a photoionization detector (PID) for the presence of volatile organic compounds (VOCs) in accordance with SOP 11 as included in the RD/RAWP (AMEC, 2014) with a minimum frequency of a reading every five feet. Dye test kits will be used to confirm LNAPL presence/absence that is suspected based on visual and PID screening. At a minimum, dye test kits will be run on soil intervals where PID screening results are greater than 250 parts per million. The selection of additional core intervals for dye testing will be subject to the judgement of the field geologist. Soil samples with positive dye test kit results will be sent off site for analysis of VOCs by Environmental Protection Agency (EPA) Method 8260B and total petroleum hydrocarbons (TPH) (sum of gasoline range organics and diesel range organics) by EPA Method 8015B. If there are indications of LNAPL presence or dissolved contamination

during screening of the soil core, decisions on continuation of the boring, installation of well components, and additional step-out locations will follow the protocols noted in **Attachment 4**.

If necessary, proposed step out boring locations will be presented in a future field variance memorandum for review by the Air Force, EPA, and Arizona Department of Environmental Quality. A call may be scheduled among members of the BCT to discuss the need for and location of step out locations.

Once wells are completed and developed, groundwater samples will be collected from the wells and analyzed for VOCs by EPA method 8260B.

Laboratory analysis for soil and groundwater will follow the methods and criteria established in the Quality Assurance Project Plan in Appendix H of Addendum 2.

5.0 REPORTING

Preliminary boring logs with dye test results and analytical results will be posted to the project Sharepoint site as they become available. Once the drilling is complete, the LNAPL characterization boring data, historical borings, LNAPL monitoring data from existing wells, and dissolved benzene concentrations in existing wells will be used to update the estimate of LNAPL extent and the remaining mass at ST012. Data and resulting mass extent updates will be presented in BCT meetings and calls. Final results and calculations will be incorporated into ST012 quarterly reports.

6.0 SCHEDULE

The project is estimated to take two to two and a half months to complete. It is anticipated that the project will begin in early October 2016, subject to approval of the scope in this Memo and will be completed in December 2016. One or two rigs will likely be in operation on the site. Drilling activities will be performed either Monday-Friday or for 10 days on and 4 days off. Drilling will be during daylight hours, with the exception of wells which may need to be drilled at night to minimize impacts to businesses at the Phoenix Mesa Gateway Airport (east of Sossaman Road).

7.0 REFERENCES

AMEC Environment & Infrastructure Inc. (AMEC), 2014. *Final Remedial Design and Remedial Action Work Plan for Operable Unit 2 Revised Groundwater Remedy, Site ST012, Former Williams Air Force Base, Mesa, Arizona*. Prepared for the Air Force Civil Engineer Center. 20 May 2014.

Amec Foster Wheeler Environment & Infrastructure Inc., 2016. *Draft Final Addendum #2, Remedial Design and Remedial Action Work Plan for Operable Unit 2 Revised Groundwater Remedy, Site ST012, Former Williams Air Force Base, Mesa, Arizona*. Prepared for the Air Force Civil Engineer Center. 15 March 2016.

ATTACHMENT 1 24 AUGUST 2016 ST012 BCT SLIDES

Air Force Civil Engineer Center

FORMER
WILLIAMS AIR FORCE BASE

Site ST012
Former Liquid Fuels Storage Area
Remedial Action

BCT Meeting
24 August 2016

Battle Ready...Built Right!

Williams AFB
BRAC Cleanup Team Meeting

Time	Agenda Item	Est. Time
8:30-8:40	**Welcome and Agenda Review**	10 min
8:40-10:30	**ST012 Update** • Summary of Site Activities (last 30 days) • Evaluation of EBR Baseline Data • Response to EPA and ADEQ Comments	110 min
10:30-10:45	**Break**	15 min
10:45-12:00	**ST012 Update con't**	75 min
12:00-12:30	**Lunch provided**	30 min
12:30-1:30	**ST012 Update con't**	60 min
1:30-2:15	**LF004 and FT002 Update**	45 min
2:15-2:30	**SS017 Update**	15 min
2:30-2:45	**Break**	15 min
2:45-3:00	**Five Year Review**	15 min
3:00-3:15	**ST035 Update**	15 min
3:15-3:30	**2016 Meeting/Conference Call Schedule** **Deliverable Status Review**	15 min
3:30-3:45	**BCT General Update** **Stakeholder Items**	15 min
3:45-4:00	**Action Items**	15 min
4:00	**BCT Meeting Adjourn**	

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ST012 Update

- Introduction
- Site Activities Update (last 30 days)
- Evaluation of Phase 1 Data
- Path Forward
- Response to EPA and ADEQ Comments

ST012 Introduction

- **Update since June BCT Meeting**
  - **28 June 2016 – EPA/ADEQ joint letter requesting halt to all activities related to decommissioning the SEE system and procuring for and constructing the EBR system**
  - **1 July 2016 – AF letter acknowledging suspension of SEE decommissioning and EBR construction**
  - **11 and 20 July 2016 – Two meetings between AF, EPA, ADEQ managers (Phil, Angeles, Tina)**
  - **28 July 2016 – EPA/ADEQ Invokes Informal Dispute**
  - **17 August 2016 – ADEQ comments on ST012 OMM Reports**
- **Characterization and containment are priorities**

ST012 Status

- Temporary halt for SEE decommissioning and EBR construction
- Enhancement and optimization of deep SVE
- Ongoing
  - SVE
  - LNAPL monitoring and removal
  - Water level and temperature monitoring
- Phase 1 Characterization completed

Phase 1 Post-Steam Investigation

- **Evaluation of Phase 1 Results**
  - **Bottom Line**
    - An additional round of borings and wells is recommended for LNAPL or dissolved phase characterization
    - Actions are recommended to achieve active containment capability
- **The Air Force is committed to remedy performance and achieving remedy objectives**
- **Activities for Phase 2 Post-Steam Investigation and Containment Construction can start immediately**

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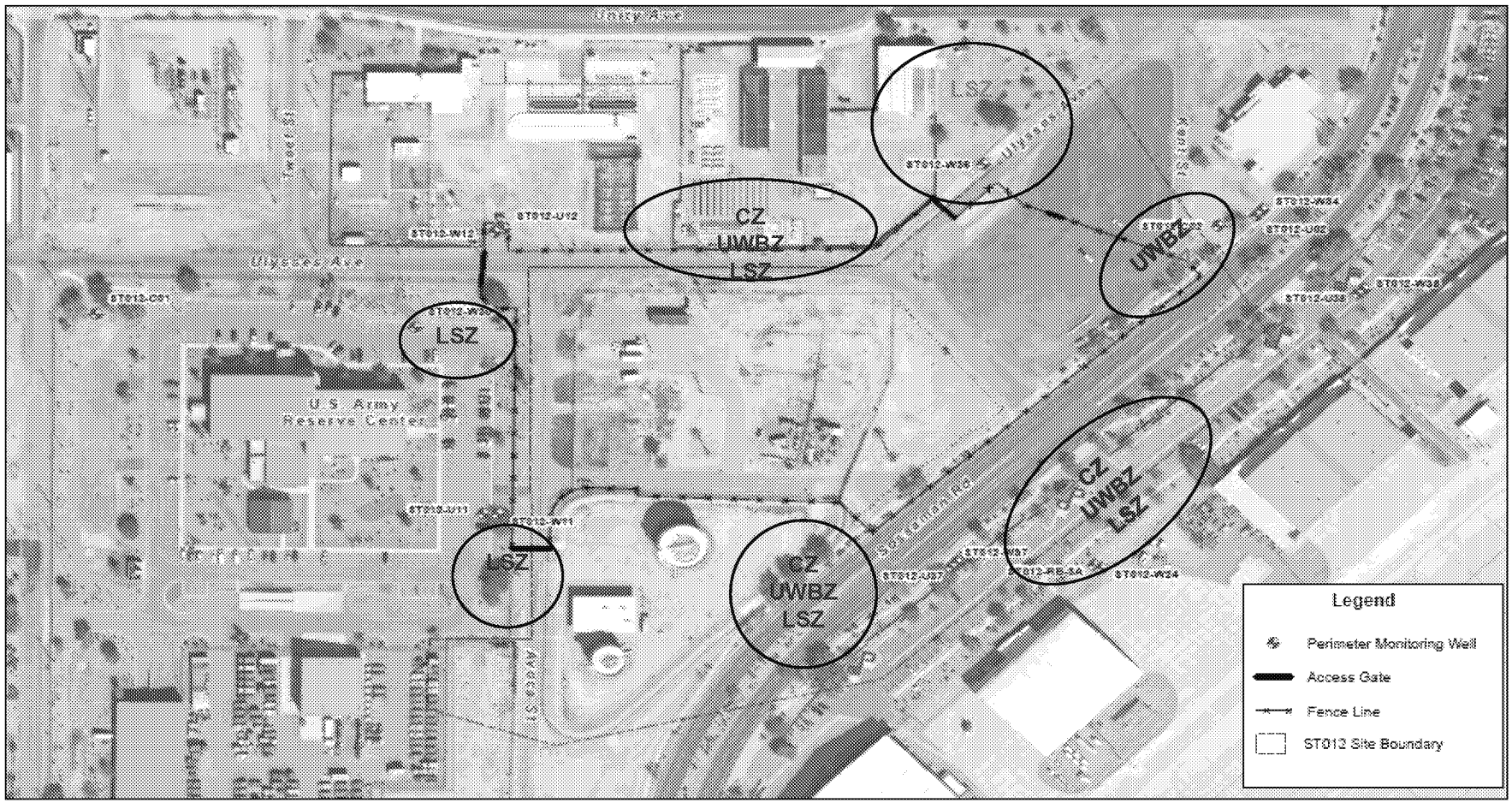
ST012 Update

- PBR objectives are designed to achieve ROD objectives
- AF Oversight and Management
  - All deliverables and responses to comments are reviewed, approved and issued by the AF
  - AF reviews and provides input to all presentation materials
  - Reviews and input on PBR approaches to achieve ROD objectives are a consistent and integrated component
- AF is the ROD signatory and heavily involved in primary, secondary and operational documents
- Presentations are performed based on project and technical responsibilities. AF manages the overall program.
- Direct discussion between regulatory and AF BCT members is encouraged at any and all times, including throughout the BCT meetings.

ST012
Additional Characterization

- **Summary of Additional Characterization**
  - Focused on areas of past ADEQ/EPA concern
  - Updated LNAPL interpretations with recent Phase 1 data
  - Phase 2 Additional Characterization consists of
    - 10 additional LNAPL characterization borings
    - 13 additional groundwater monitoring well
    - Some locations may be combined
  - Construct extraction and treatment capability for active containment

Site ST012 EPA/ADEQ Concerns for LNAPL and Groundwater (Benzene) Characterization



Red – LNAPL and dissolved phase

Green – dissolved phase

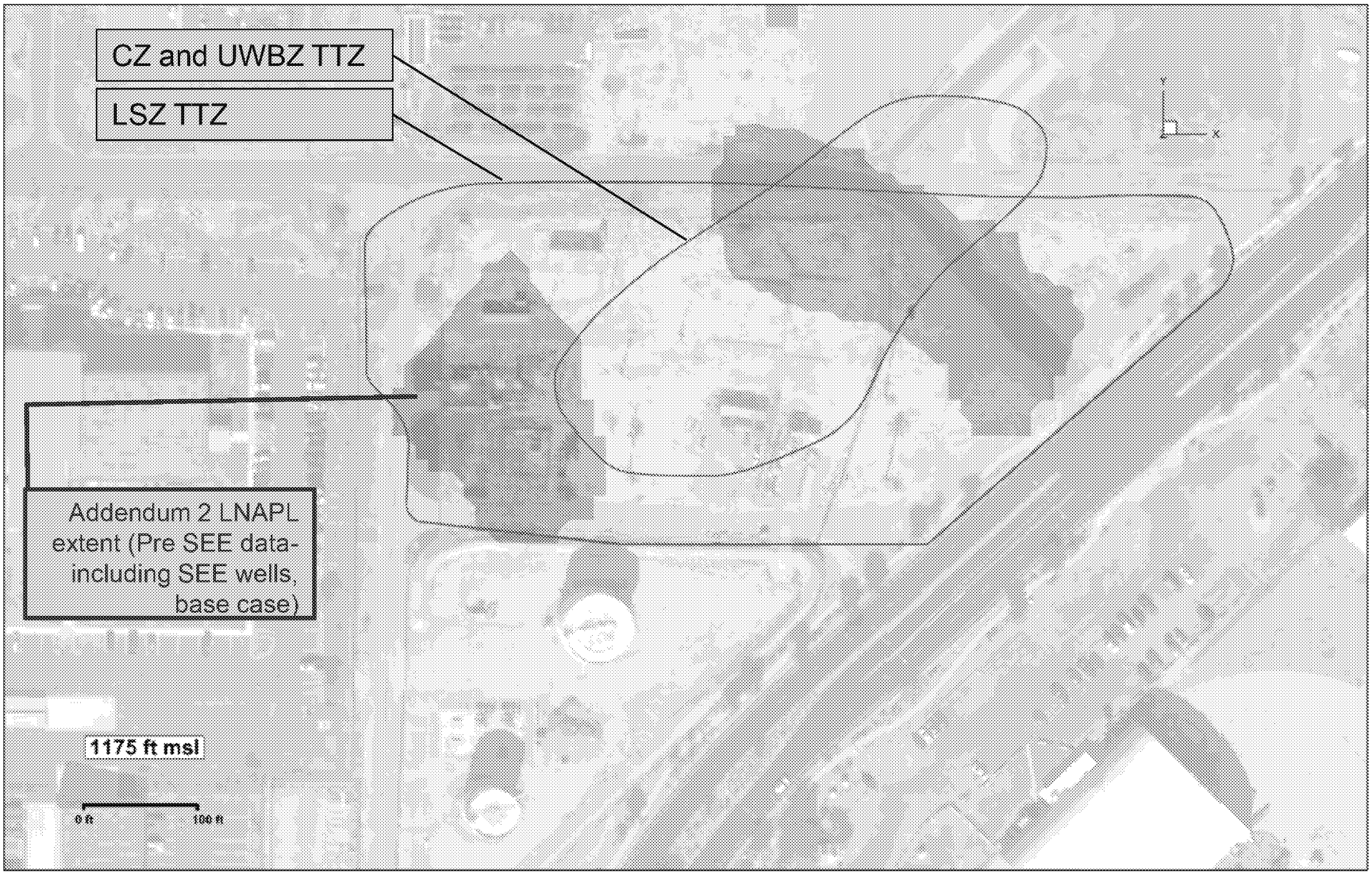
Blue – LNAPL

Area of EPA/ADEQ comment

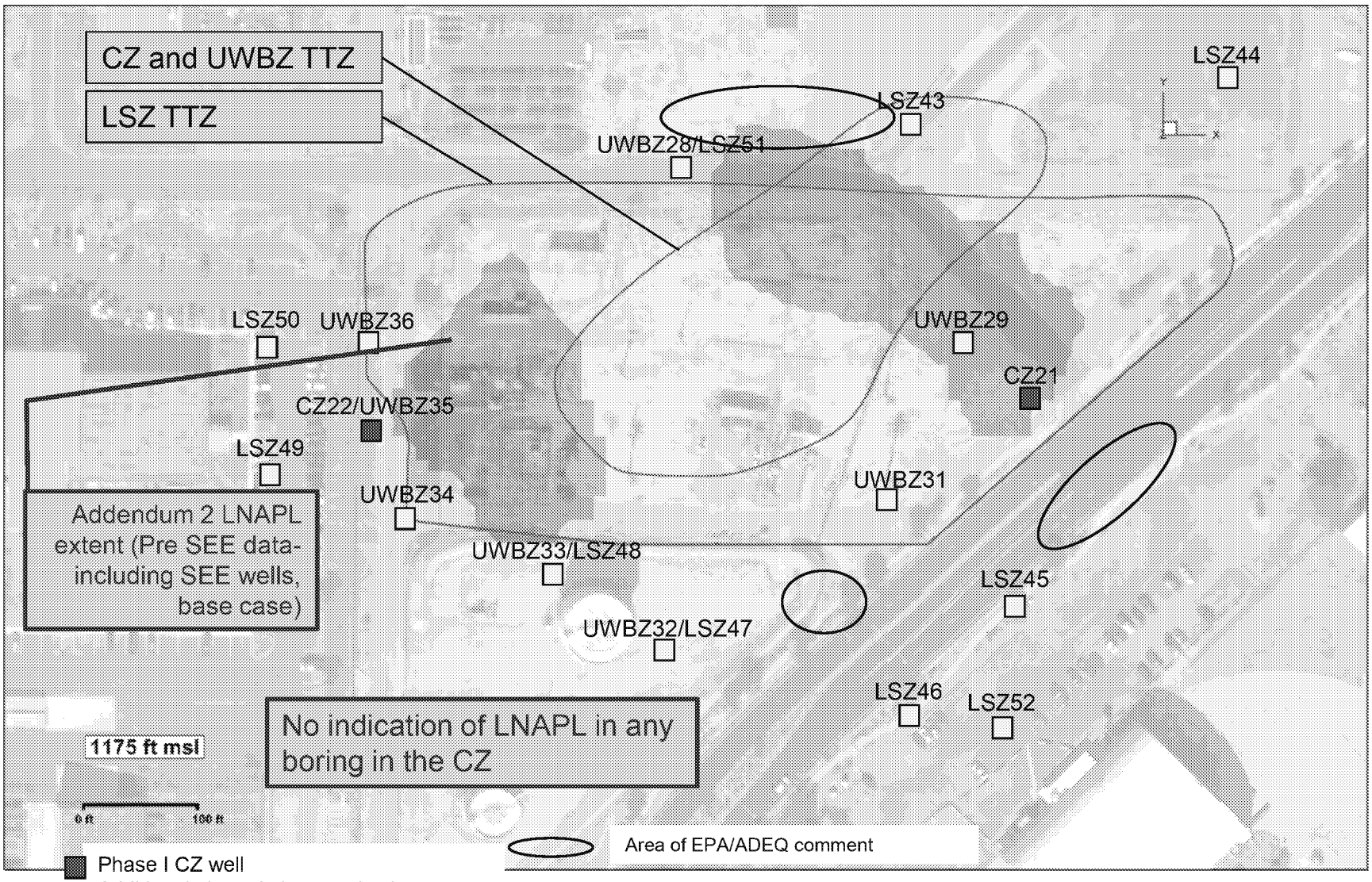
Site ST012 Additional Characterization

- **Review of LNAPL Delineation**
  - **Historical logs/interpretations**
  - **Update with**
    - **New well dye test kit results (supported by analytical)**
    - **LNAPL observations in wells (through 8/5/16)**
    - **LNAPL removed (through 8/5/16)**

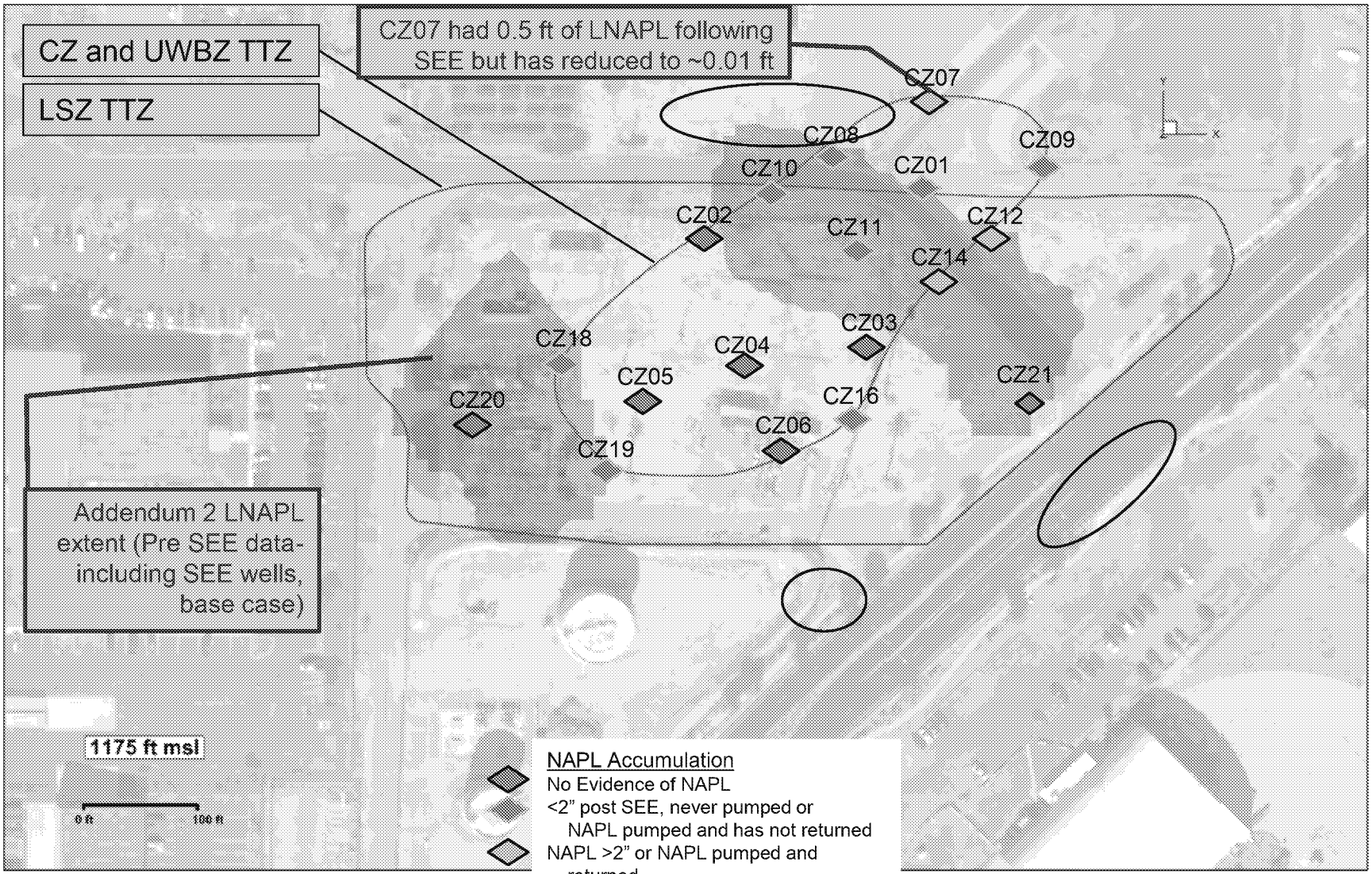
Evaluation of CZ LNAPL Characterization Based on Pre SEE Data



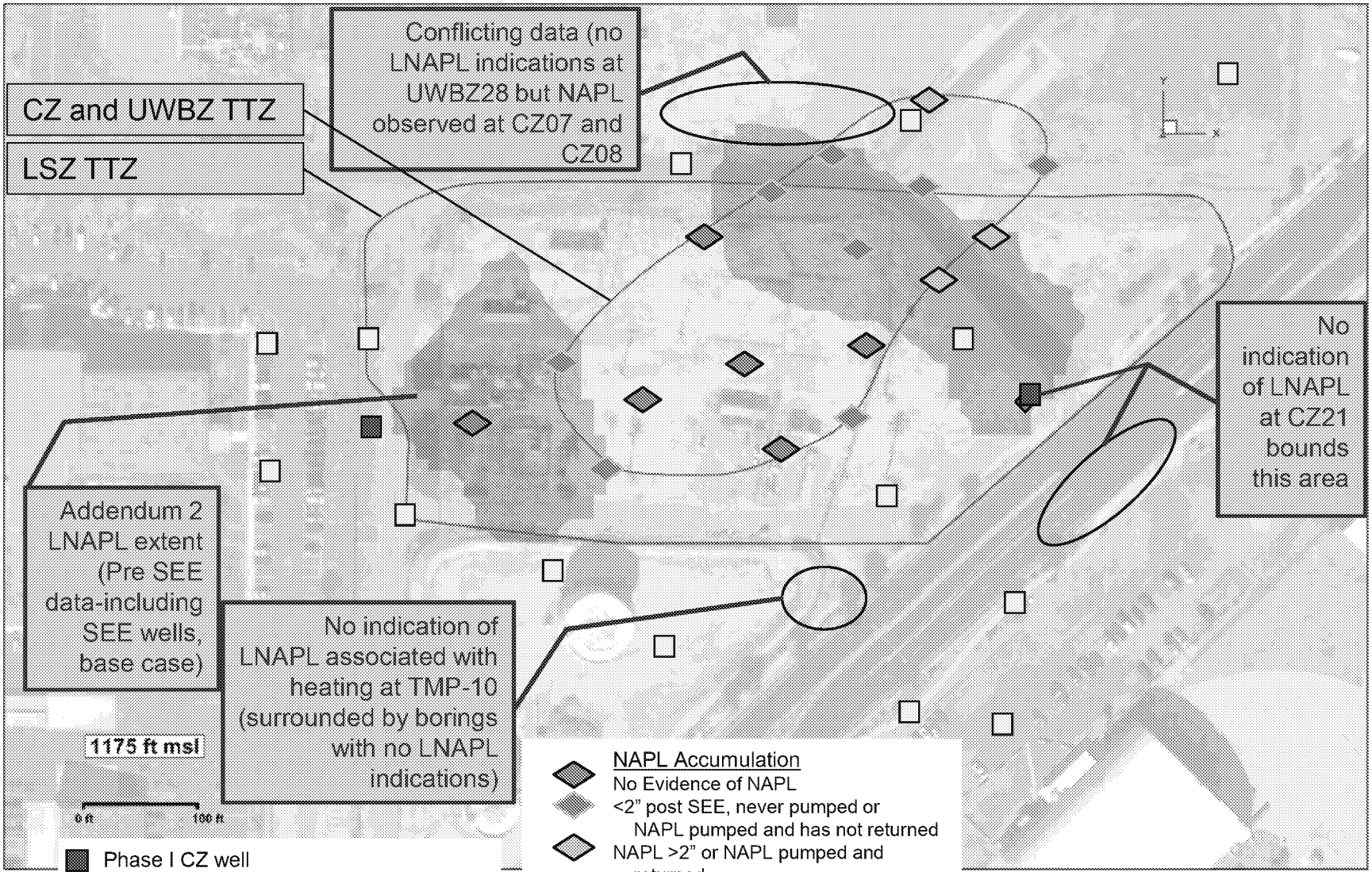
Evaluation of CZ LNAPL Characterization LNAPL Indications/Dye Test



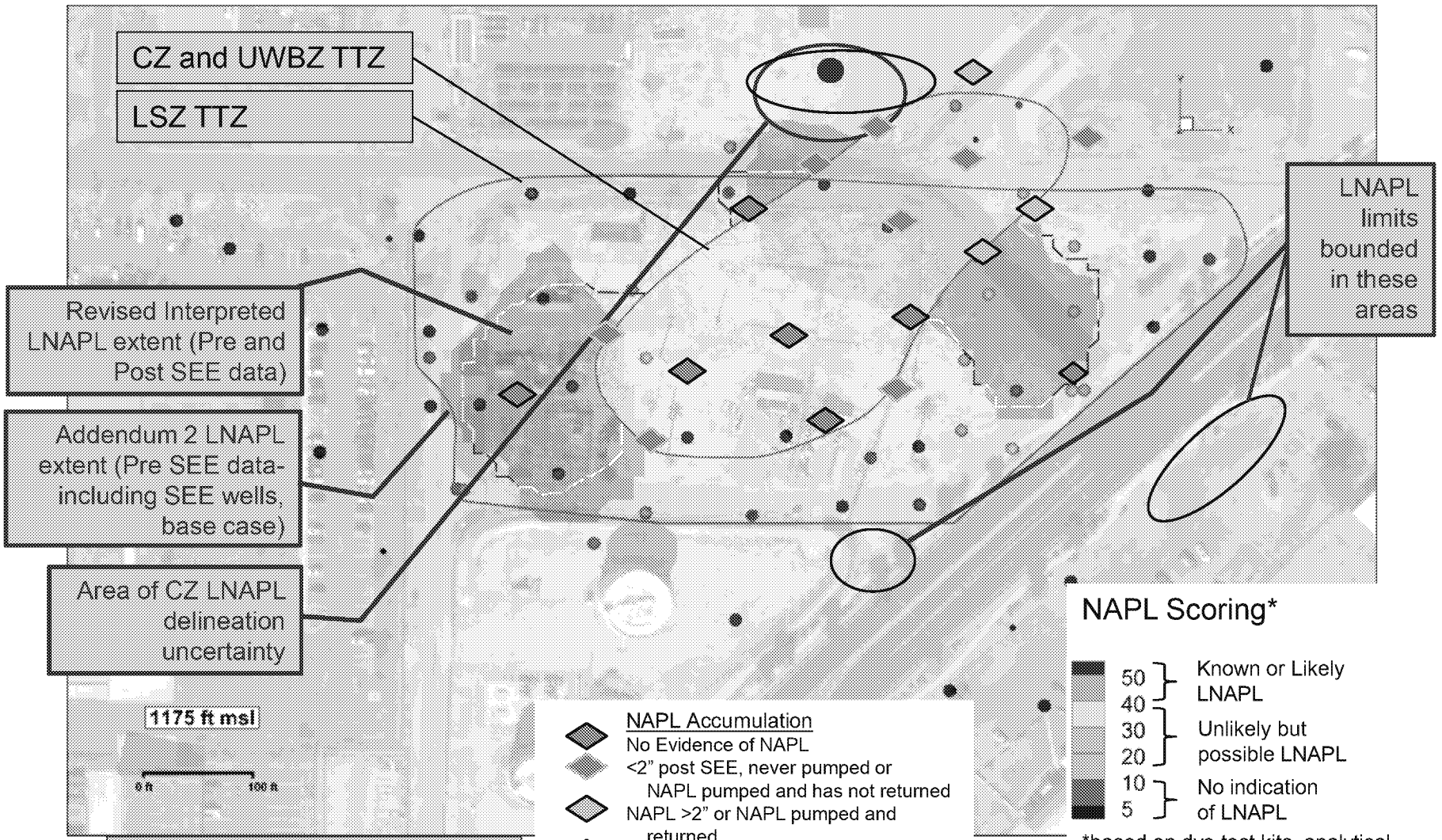
Evaluation of CZ LNAPL Characterization
Post SEE LNAPL Presence



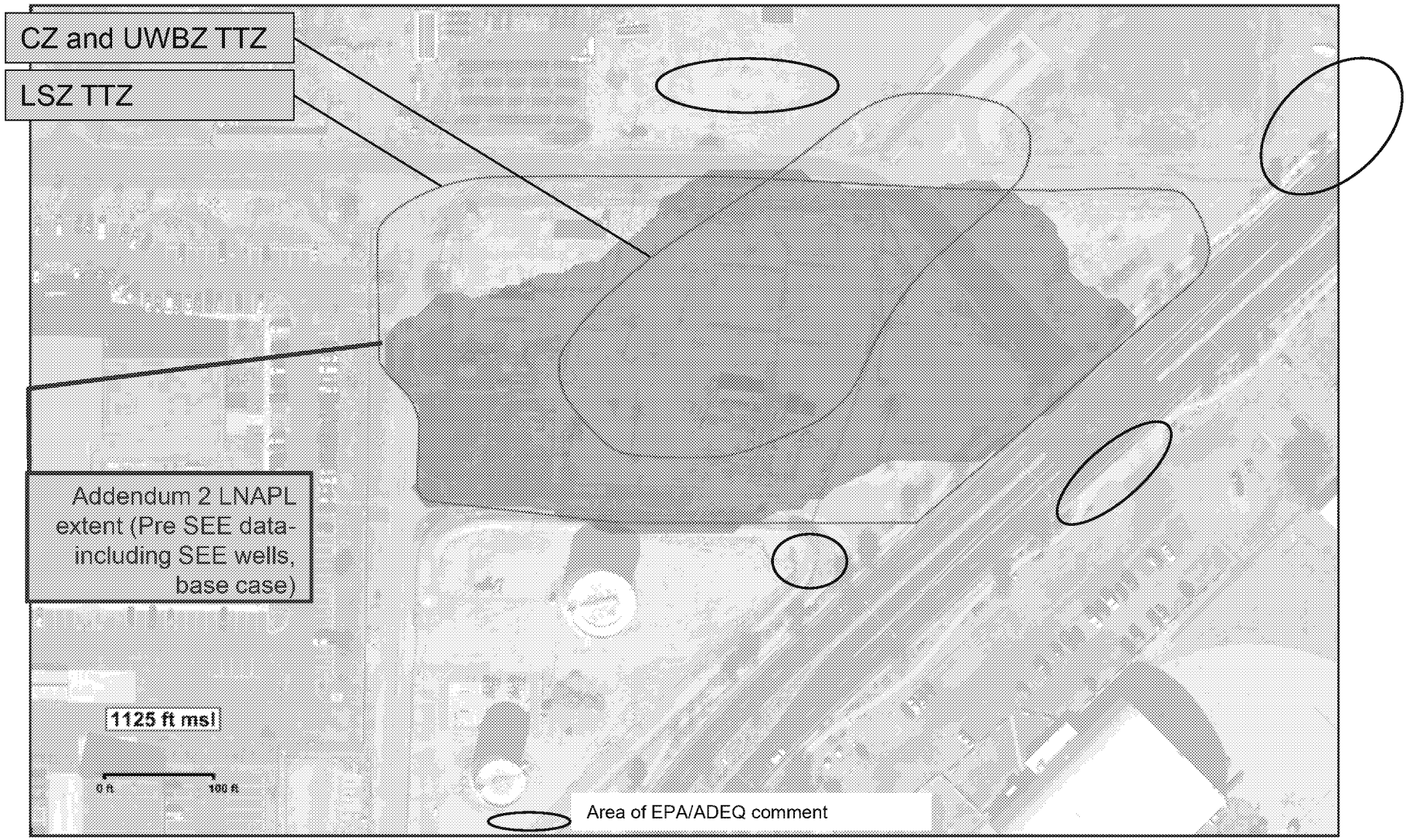
Evaluation of CZ LNAPL Characterization
Summary of Phase 1 LNAPL Data



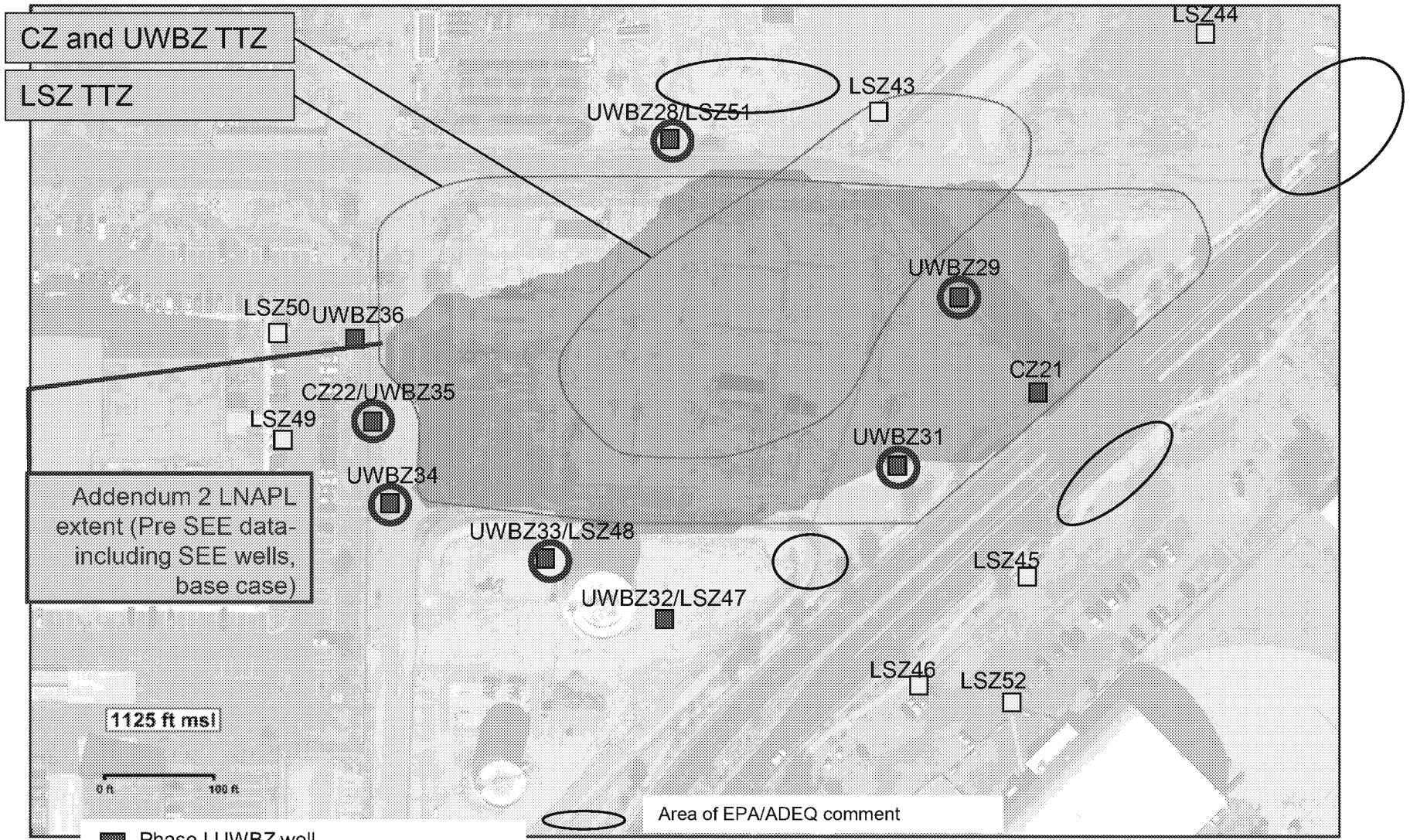
LNAPL Revised Interpretation
Cobble Zone



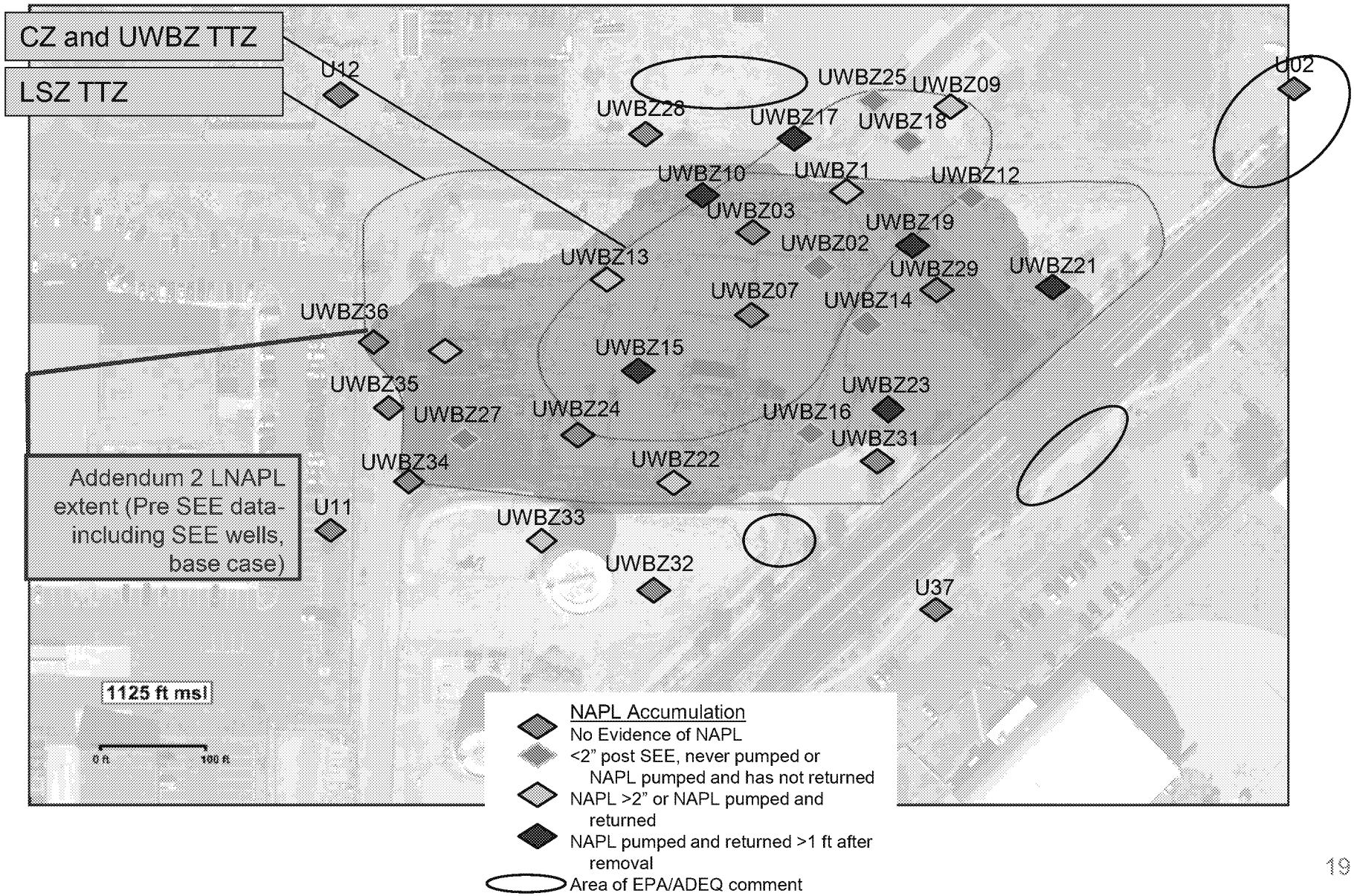
Evaluation of UWBZ LNAPL Characterization Based on Pre SEE Data



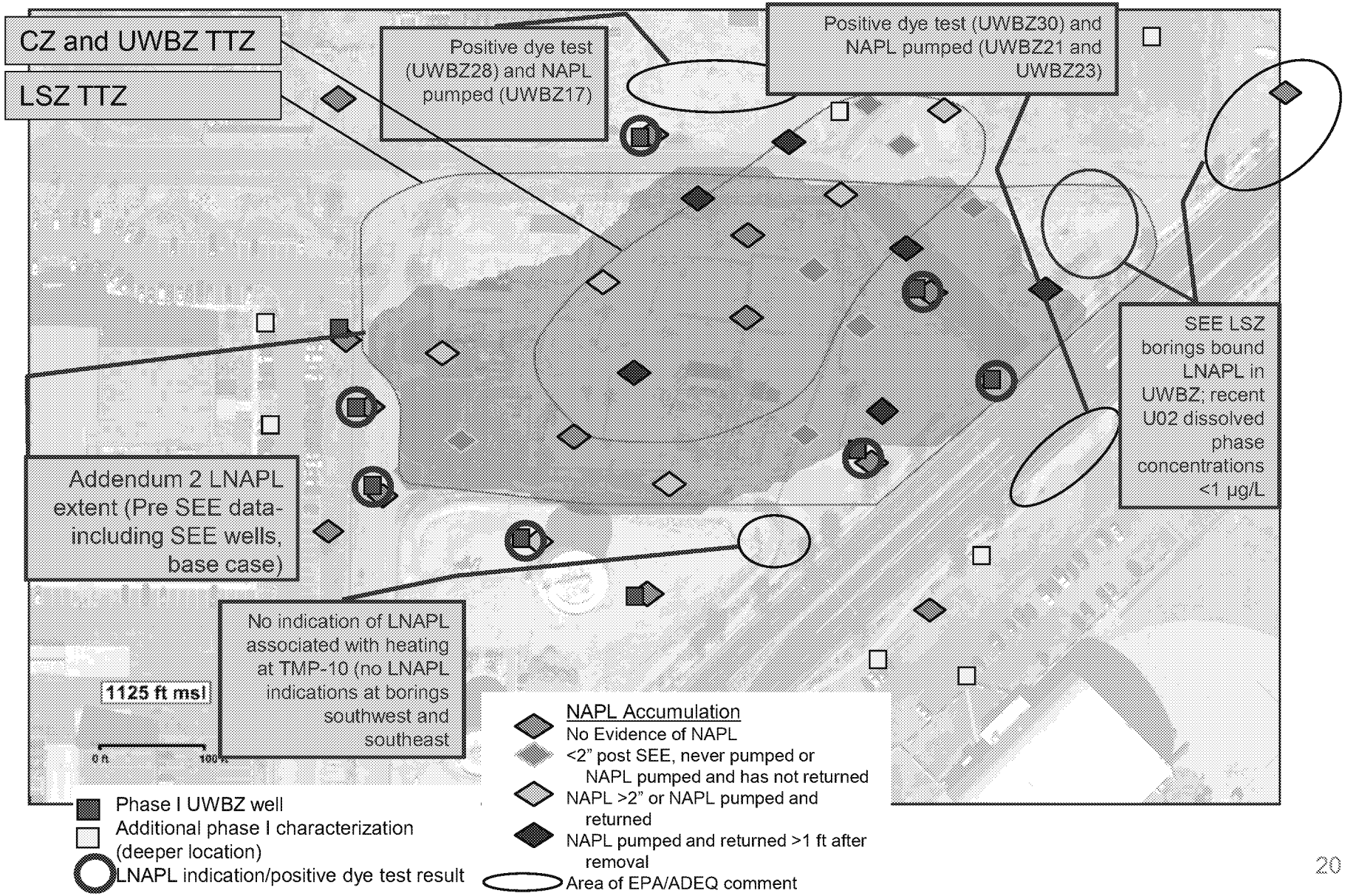
Evaluation of UWBZ LNAPL Characterization
LNAPL Indications/DyeTest



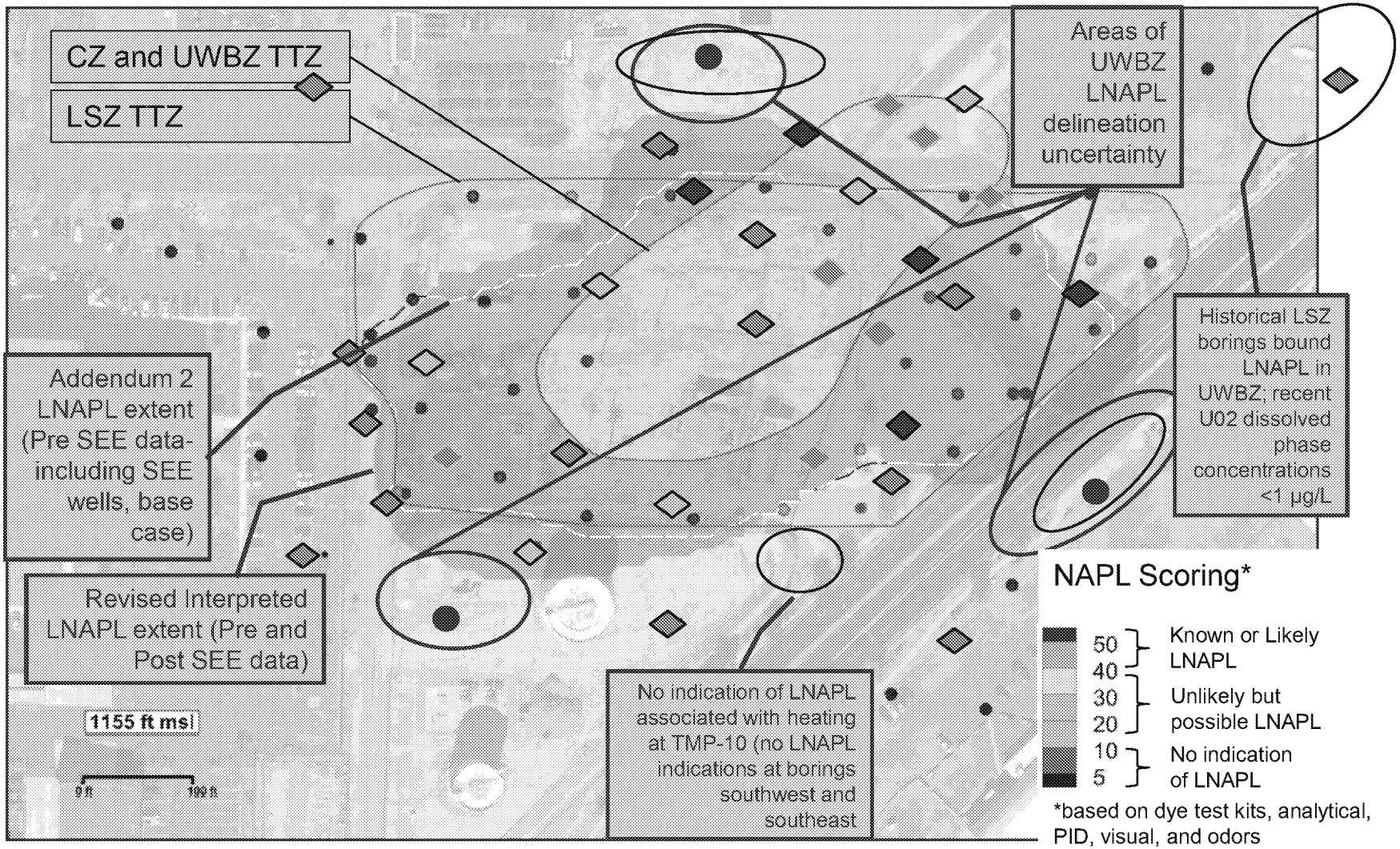
Evaluation of UWBZ LNAPL Characterization
Post SEE LNAPL Presence



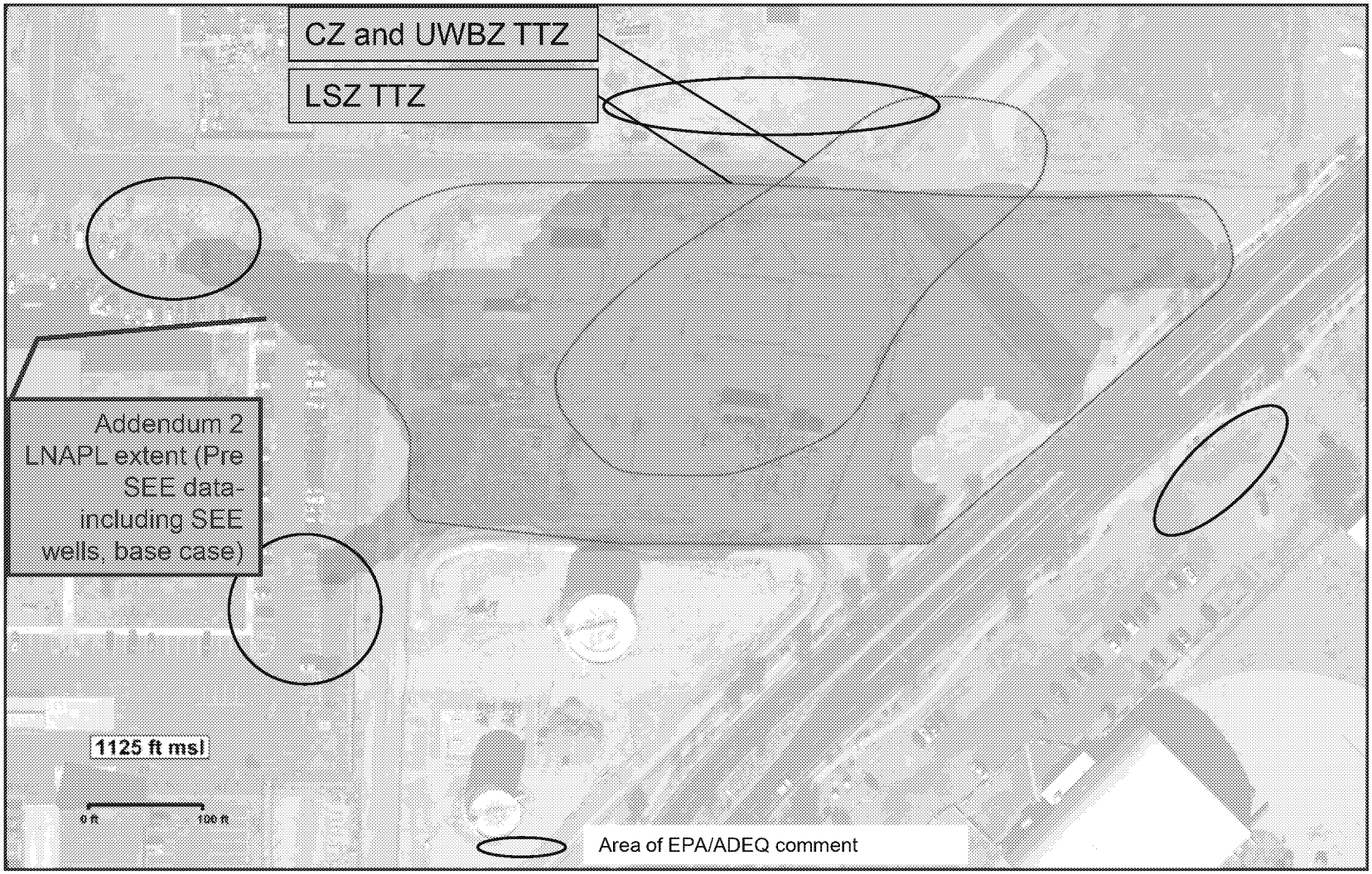
Evaluation of UWBZ LNAPL Characterization
Summary of Phase 1 LNAPL Data



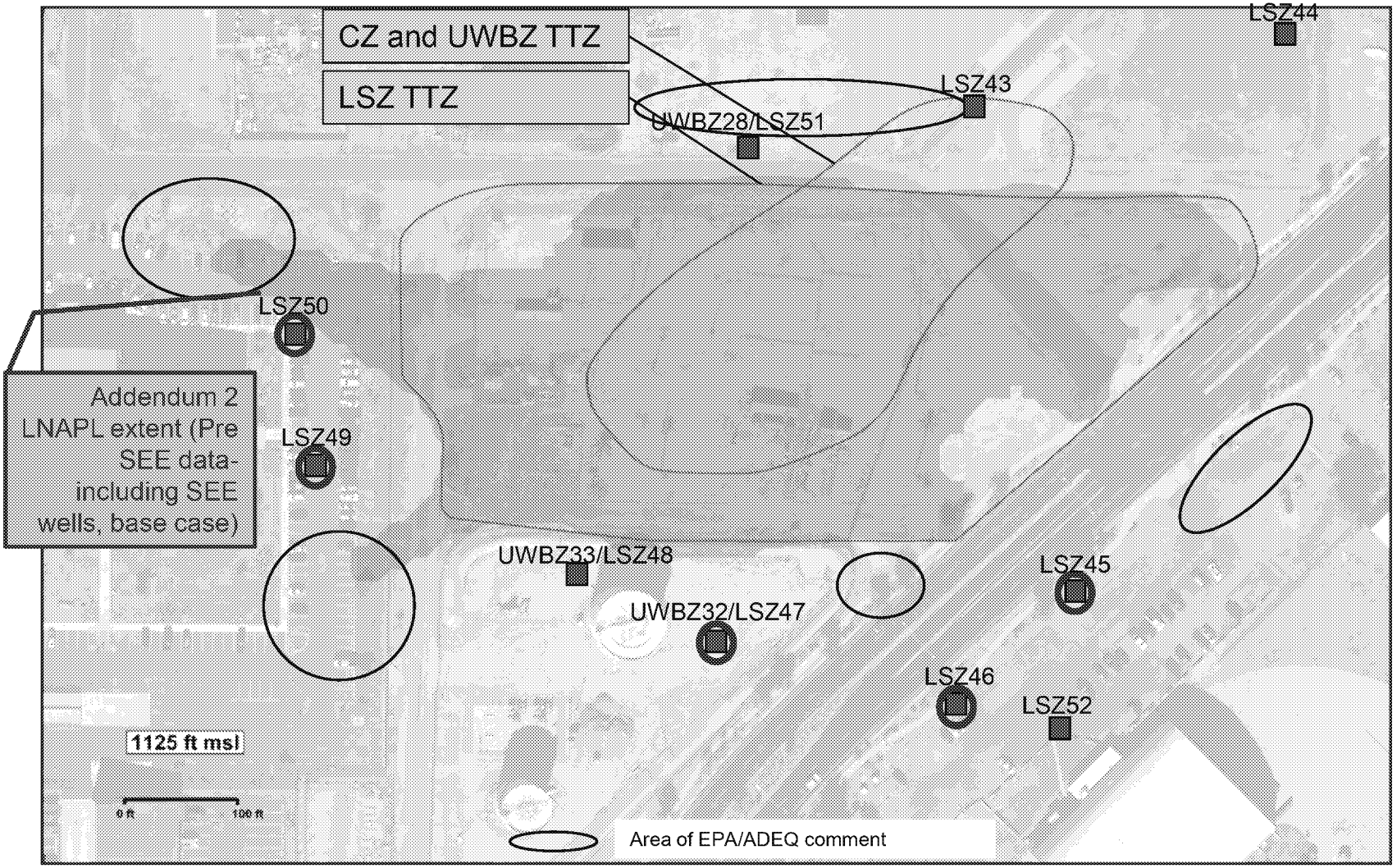
LNAPL Revised Interpretation Upper Water Bearing Zone



Evaluation of LSZ LNAPL Characterization Based on Pre SEE Data



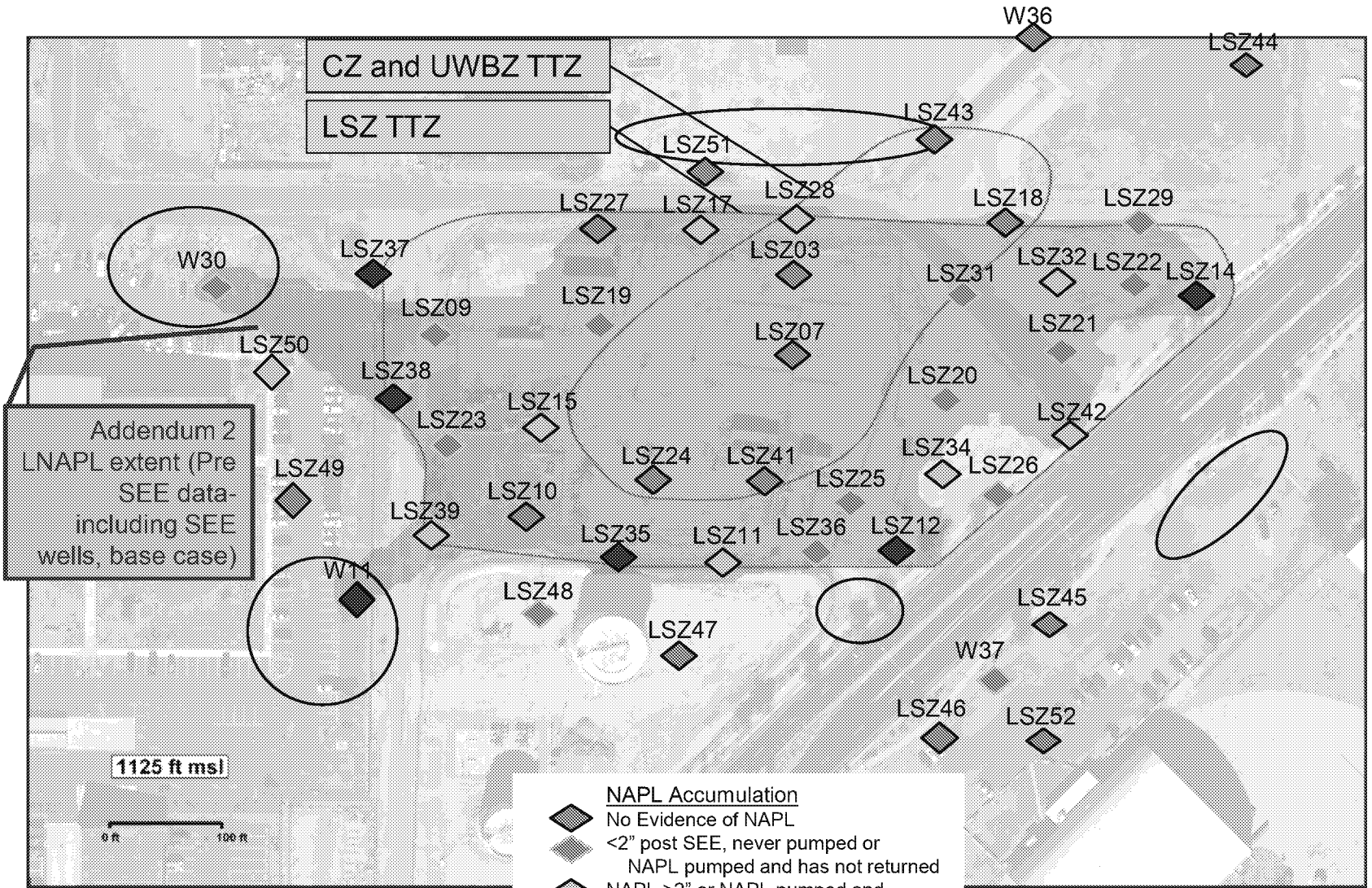
Evaluation of LSZ LNAPL Characterization
LNAPL Indications/Dye Test



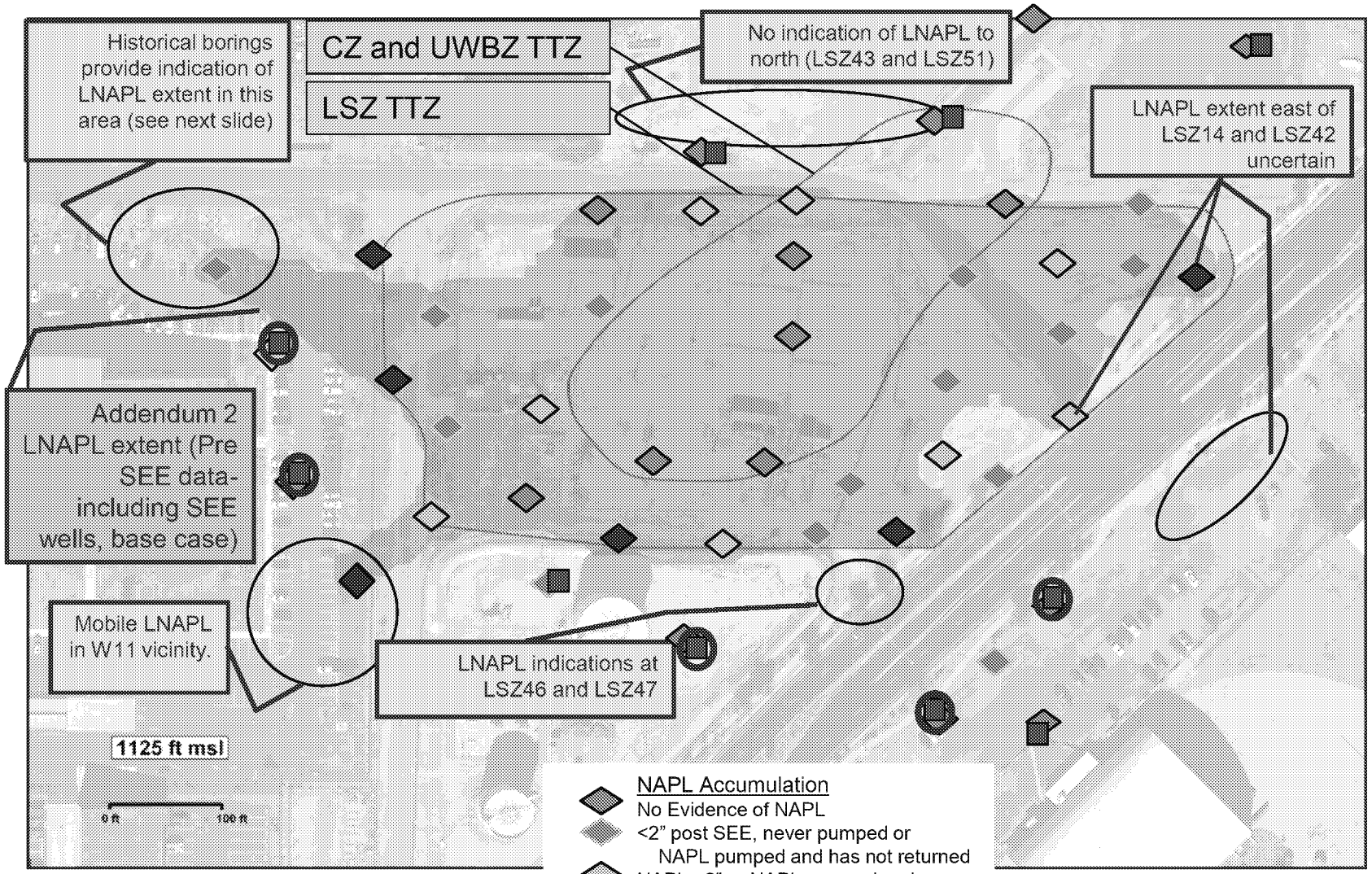
Phase I LSZ Well

LNAPL indication/positive dye test result

Evaluation of LSZ LNAPL Characterization
Post SEE LNAPL Presence

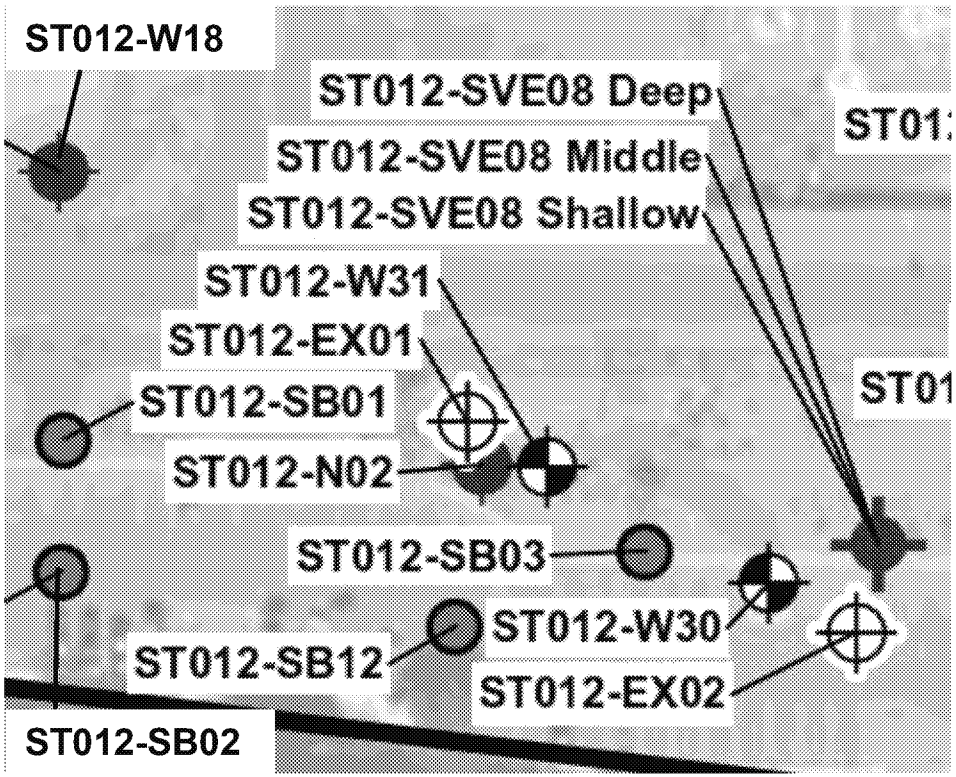


Evaluation of LSZ LNAPL Characterization
Summary of Phase 1 LNAPL Data



Evaluation of LNAPL Characterization
W-30 Area

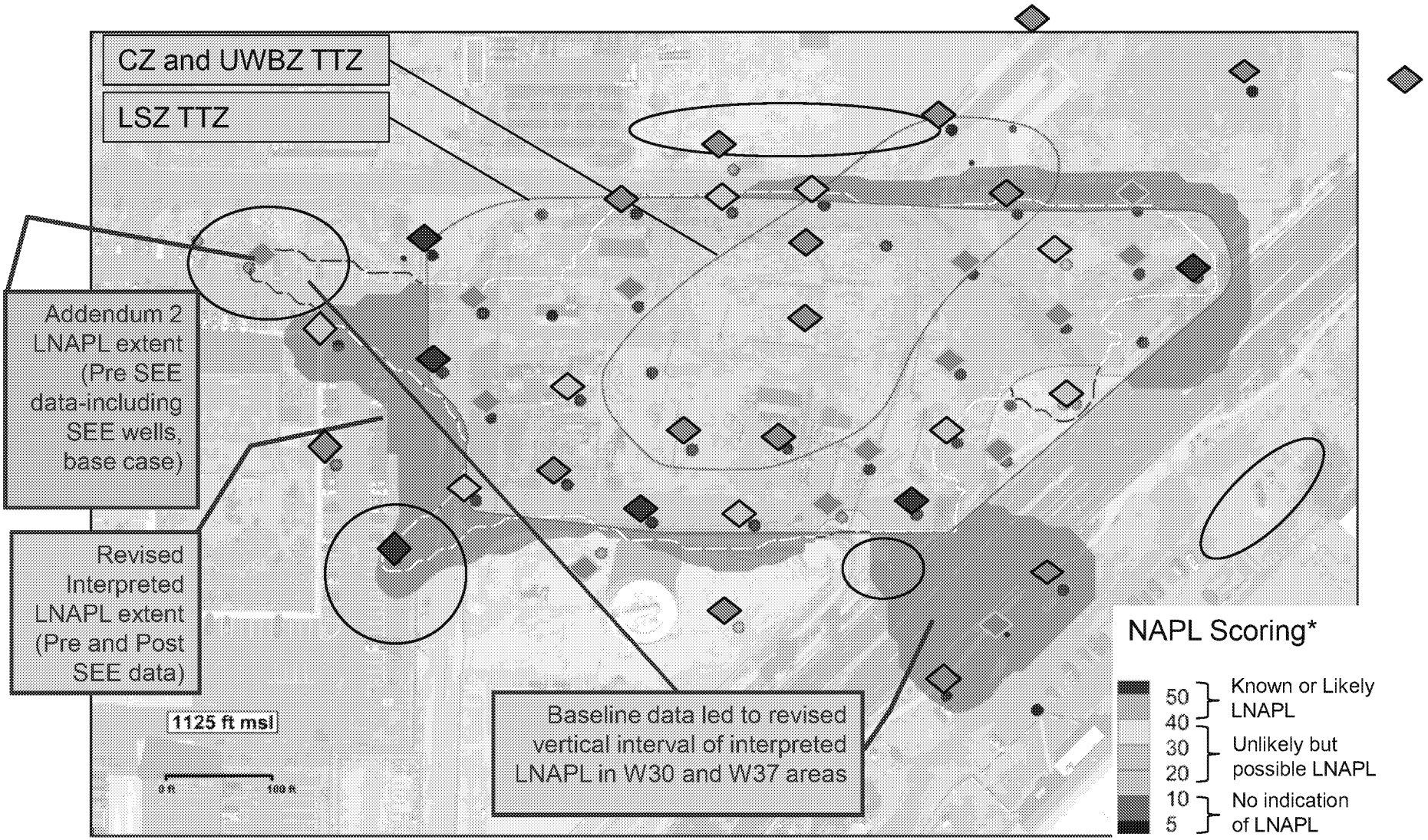
W-30 Area (Historical Borings)



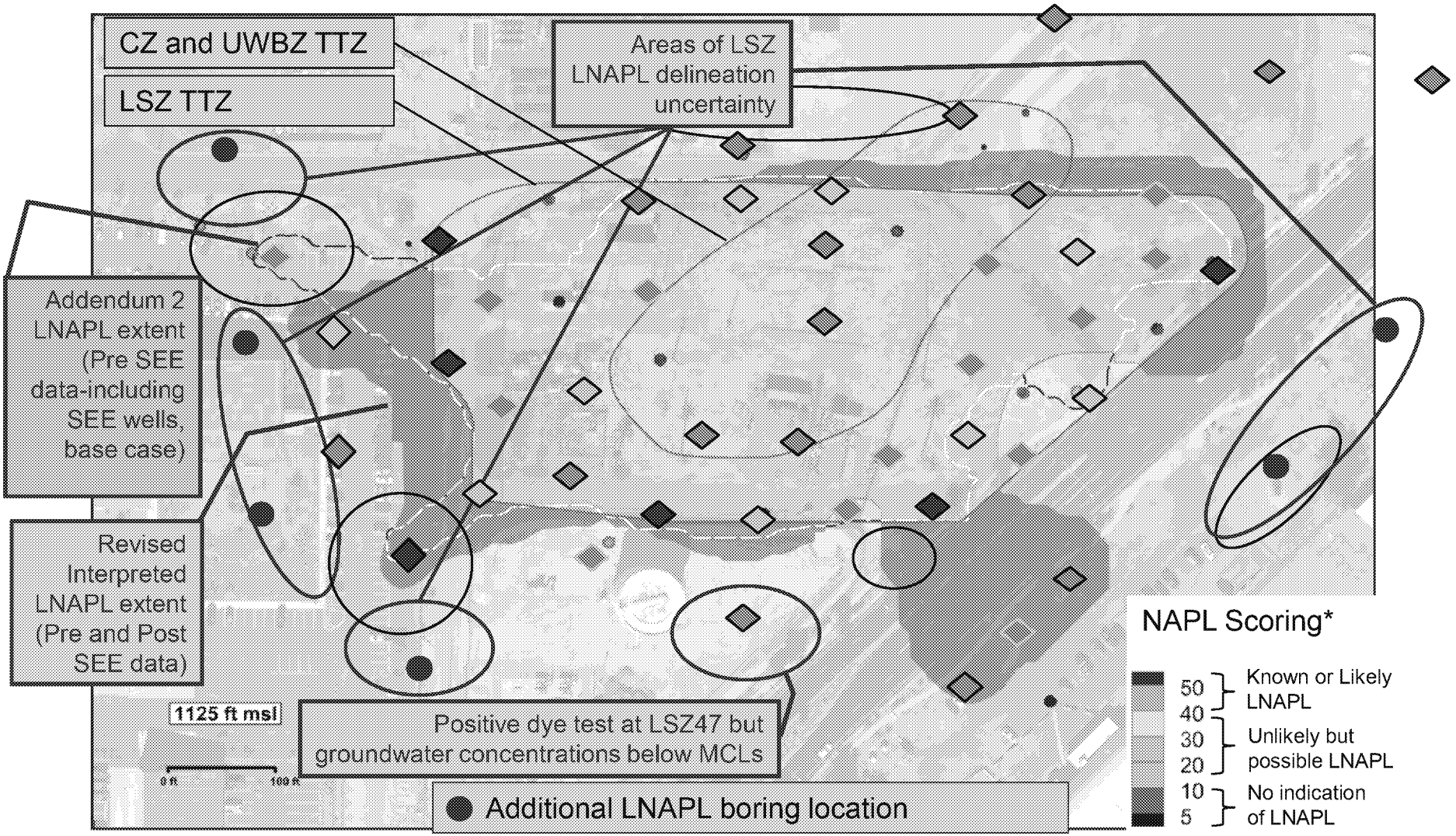
- SB01
  - No indication of NAPL to 220 ft bgs
  - Odor and 29 mg/kg TPH at 220 ft bgs
- SB02
  - No indication of NAPL to 220 ft bgs
  - 17 mg/kg TPH at 220 ft bgs
- SB03
  - Likely NAPL at 215 to 220 ft bgs
  - Odor, benzene 20 mg/kg, TPH 3,200 mg/kg
- SB12
  - Possible NAPL at 212 to 217 ft bgs
  - Visible staining, odor, but soil analysis not available
- N02
  - Likely NAPL at 216 to 222 ft bgs
  - Strong odors, PID >1,000 ppm
- W18
  - Boring log not available
- W31
  - Boring log not available

LNAPL extent extends west past SB12 and N02 but is bounded by SB01 and SB02 locations.

LNAPL Revised Interpretation
Lower Saturated Zone



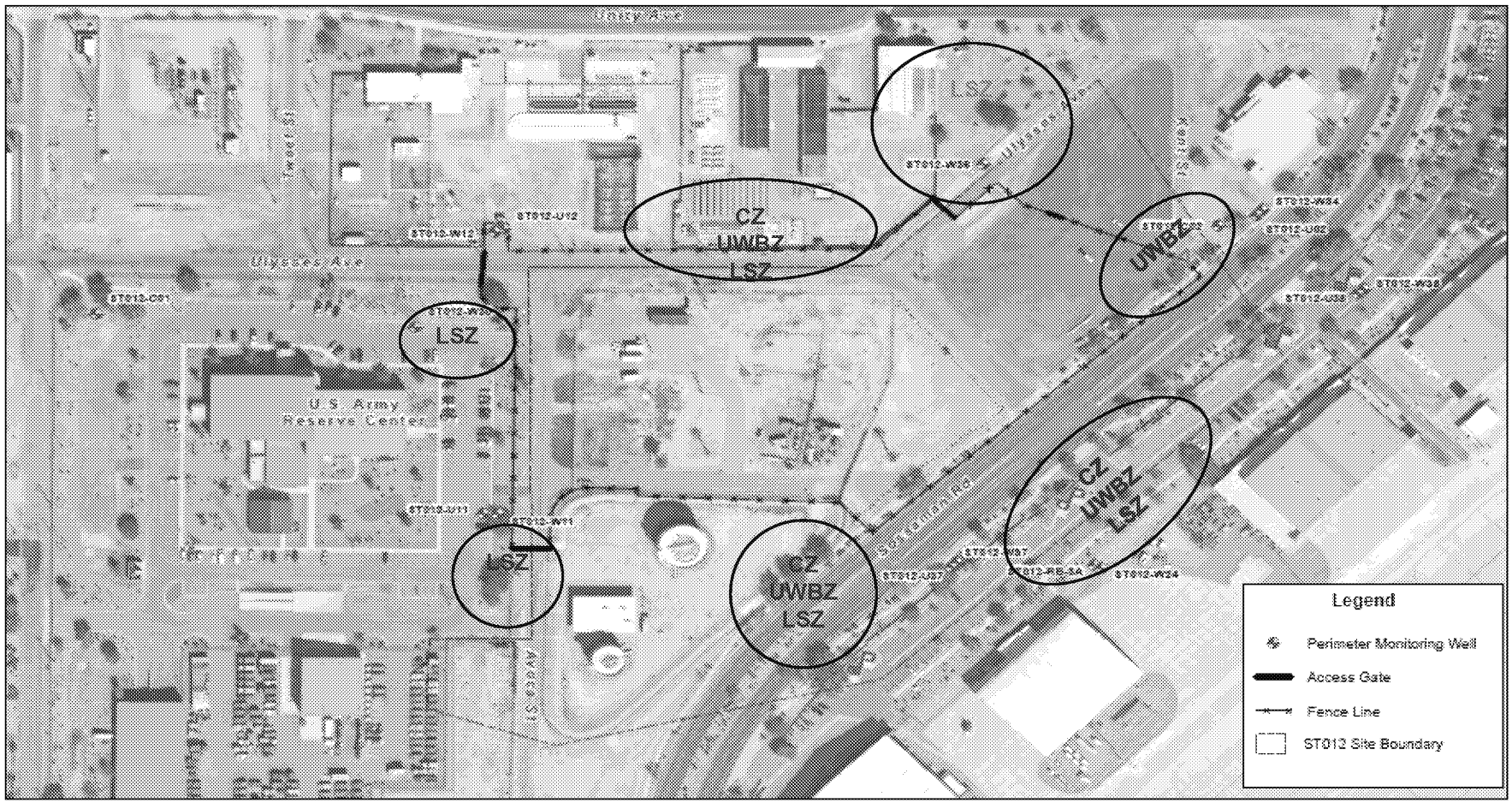
LNAPL Revised Interpretation
Lower Saturated Zone



Site ST012 Groundwater Characterization

- **Groundwater Characterization**
  - **Evaluate EBR baseline and perimeter well groundwater data**
  - **Focus on dissolved phase concentrations of COCs**
    - **Benzene**
    - **BTEX+naphthalene**

Site ST012 EPA/ADEQ Concerns for LNAPL and Groundwater (Benzene) Characterization



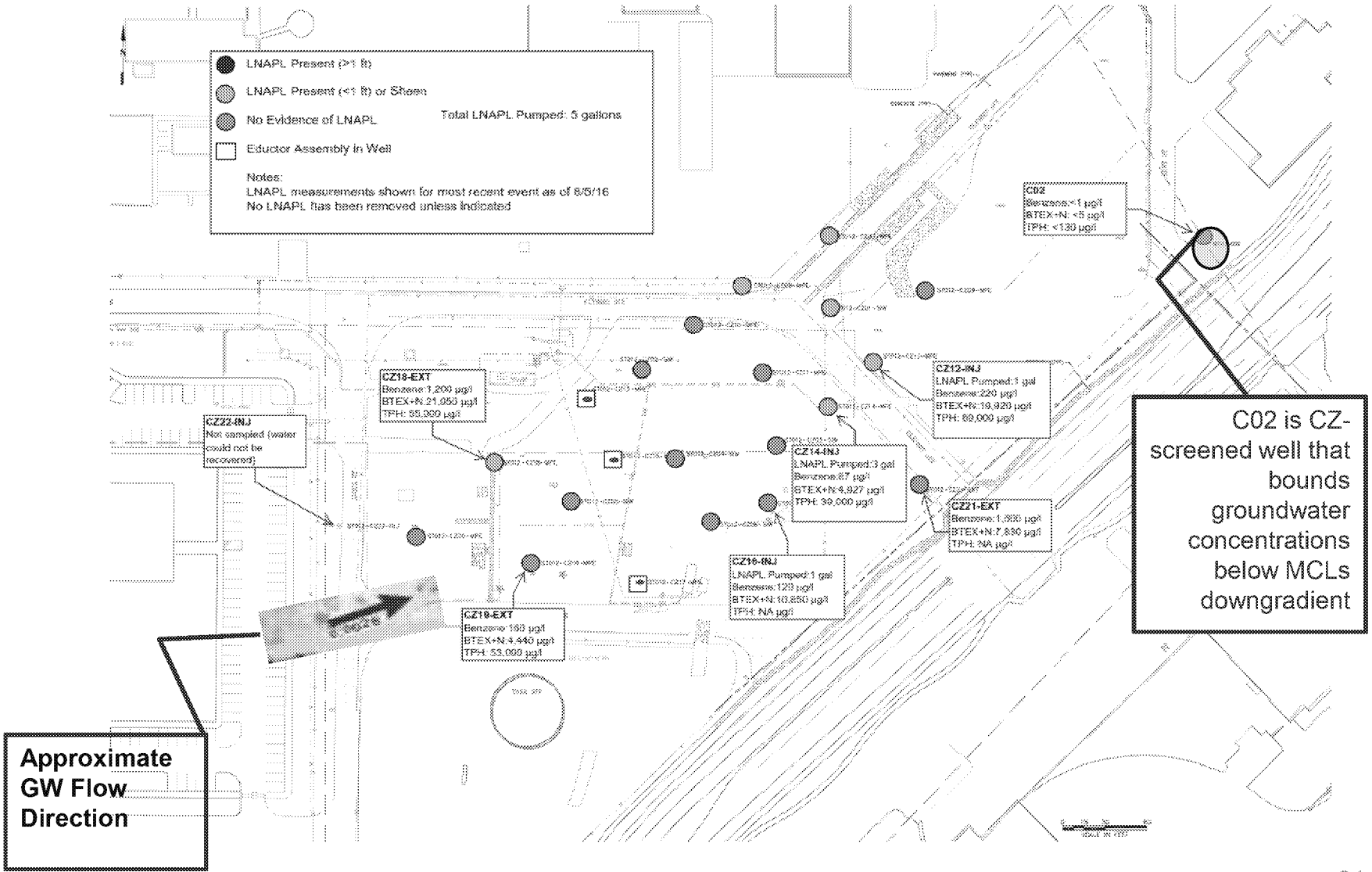
Red – LNAPL and dissolved phase

Green – dissolved phase

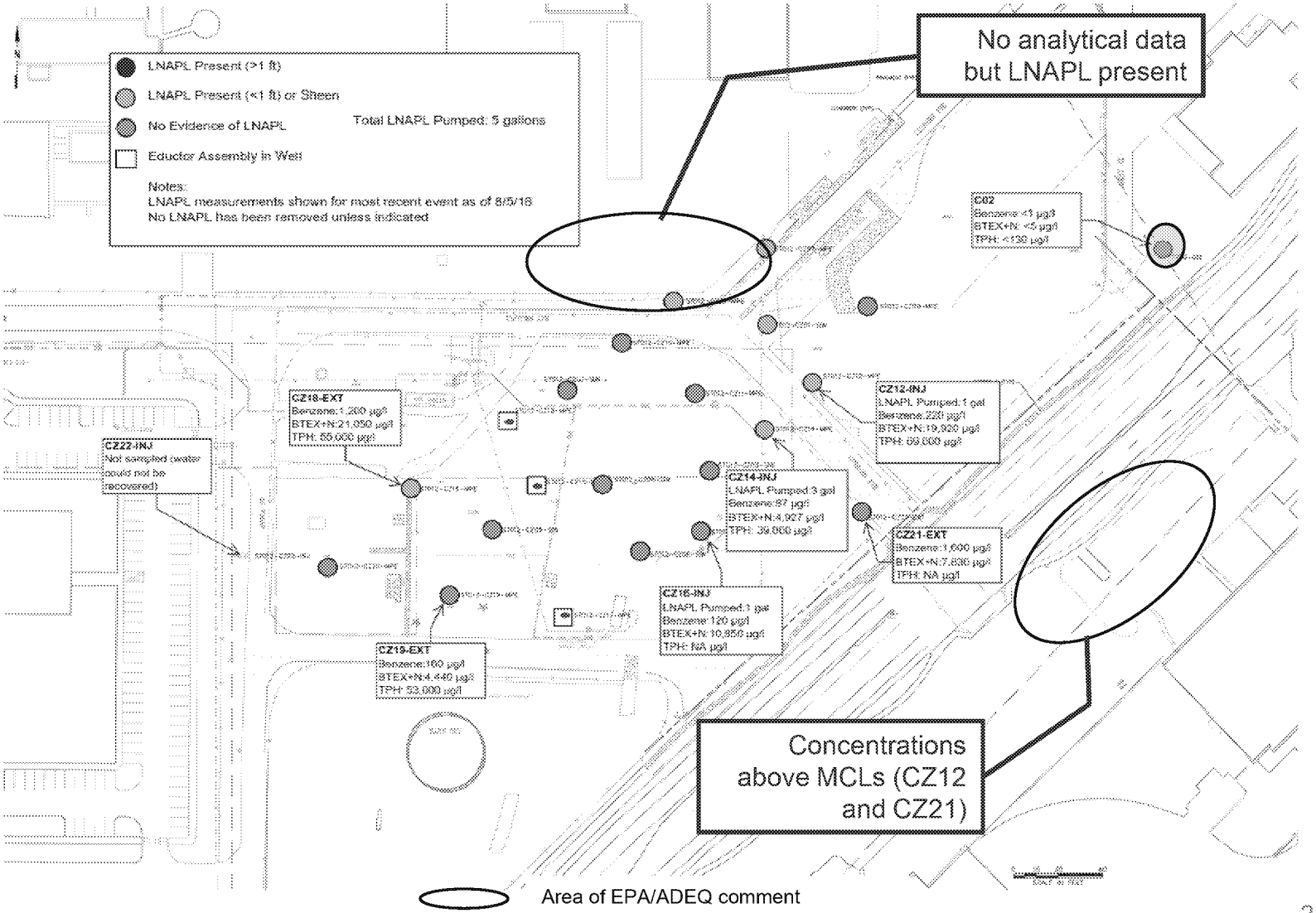
Blue – LNAPL

Area of EPA/ADEQ comment

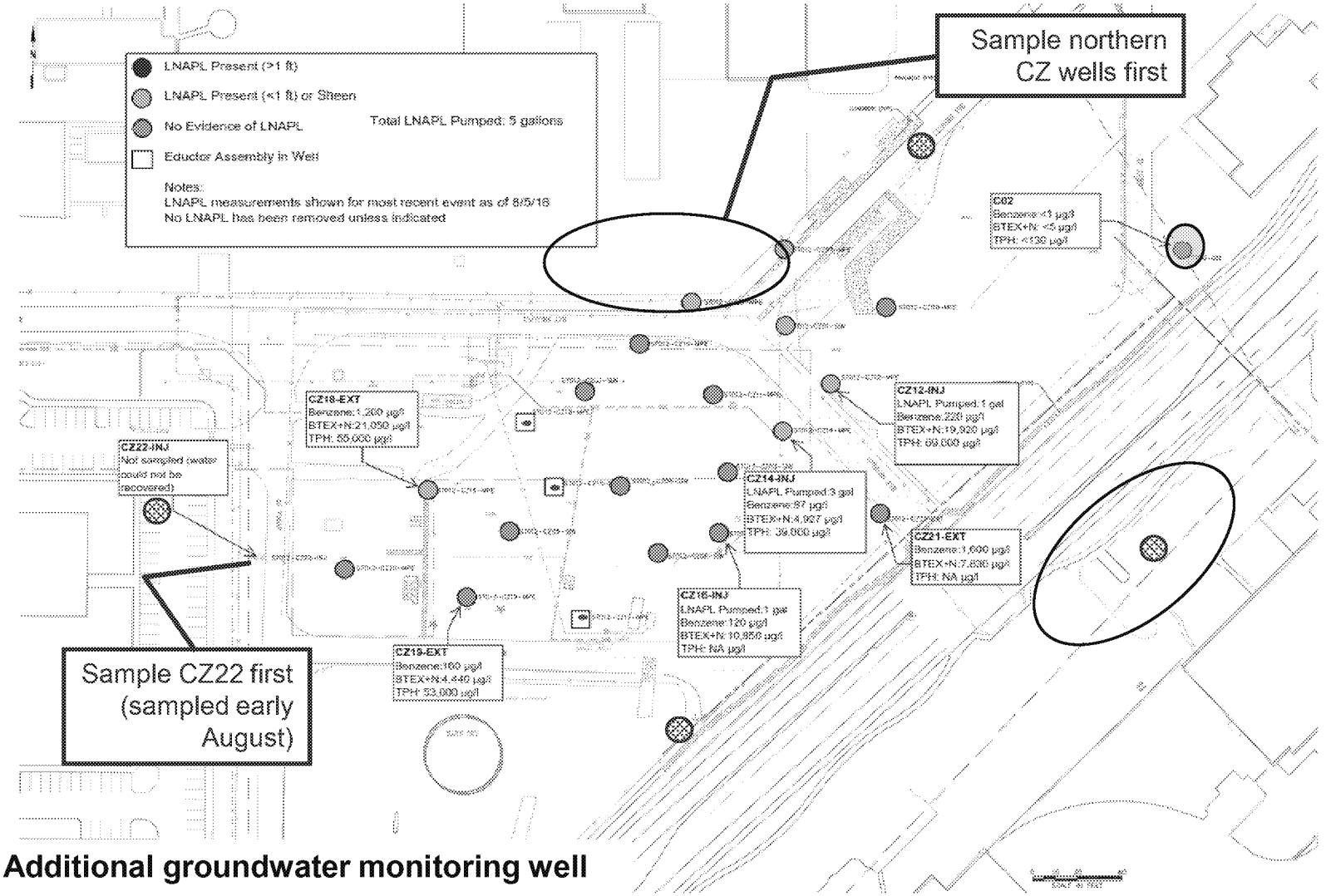
Site ST012 CZ Dissolved Phase Concentrations



Site ST012 CZ Evaluation of EPA/ADEQ Concerns



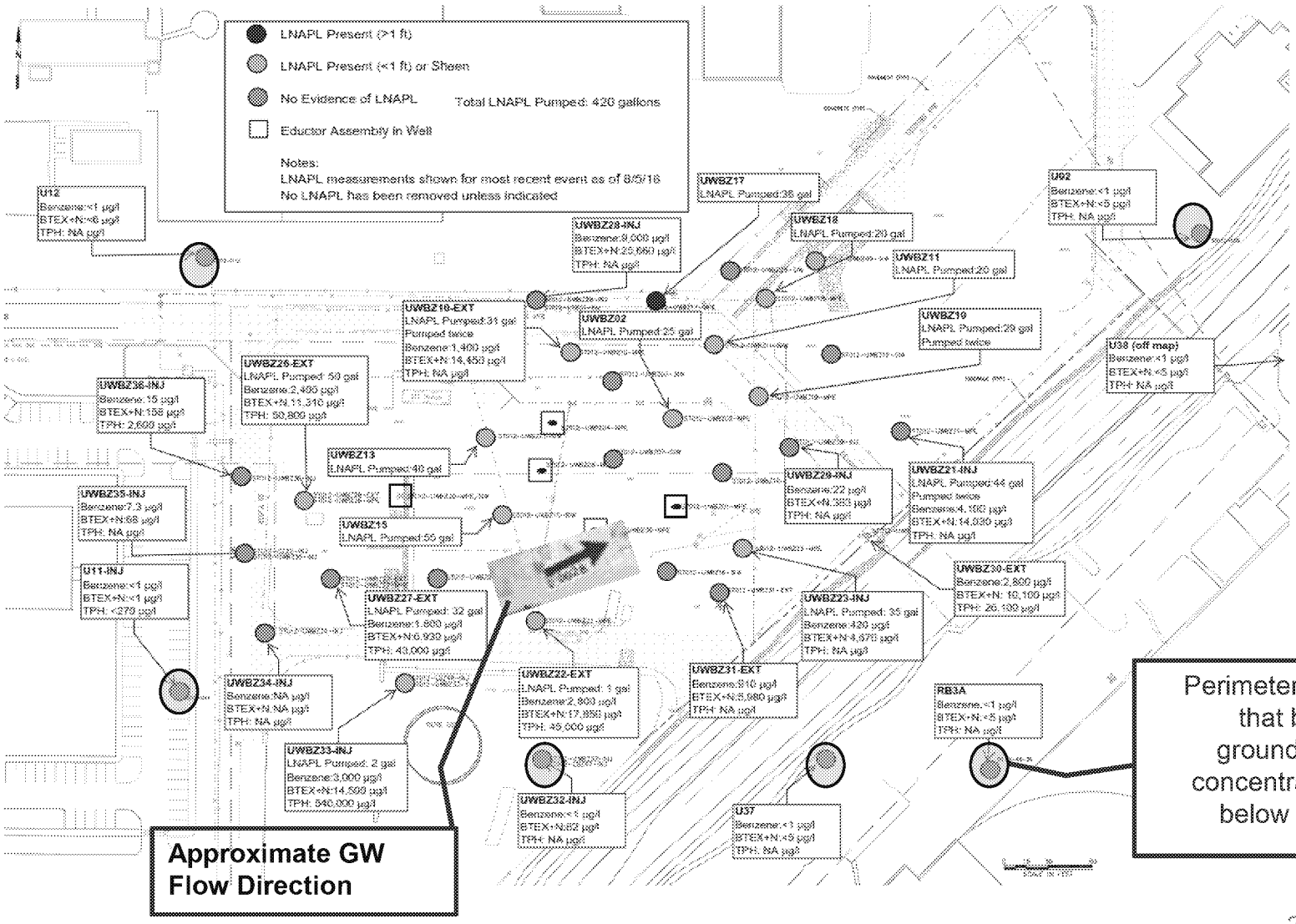
Site ST012 CZ Additional Characterization



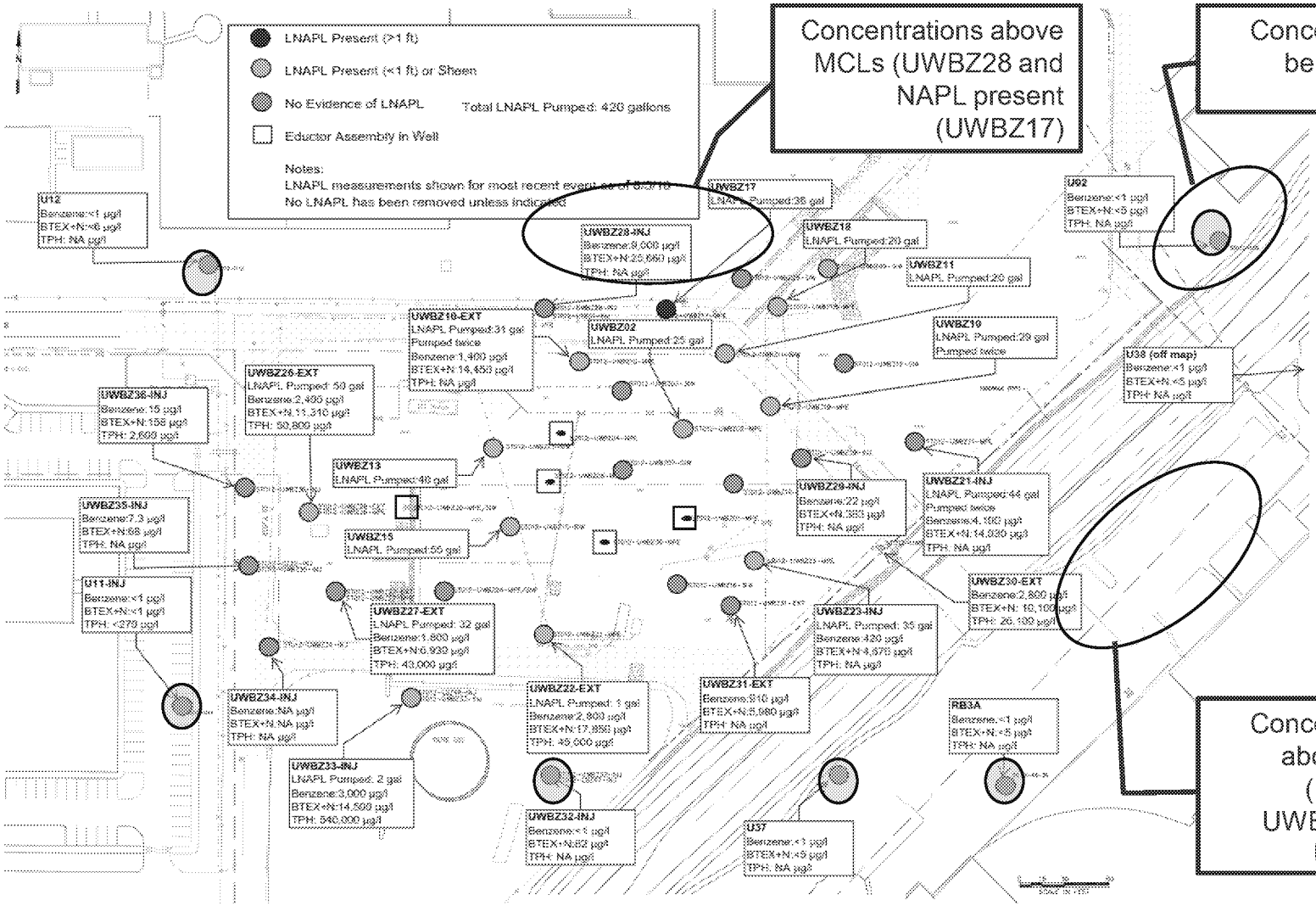
Additional groundwater monitoring well

Area of EPA/ADEQ comment

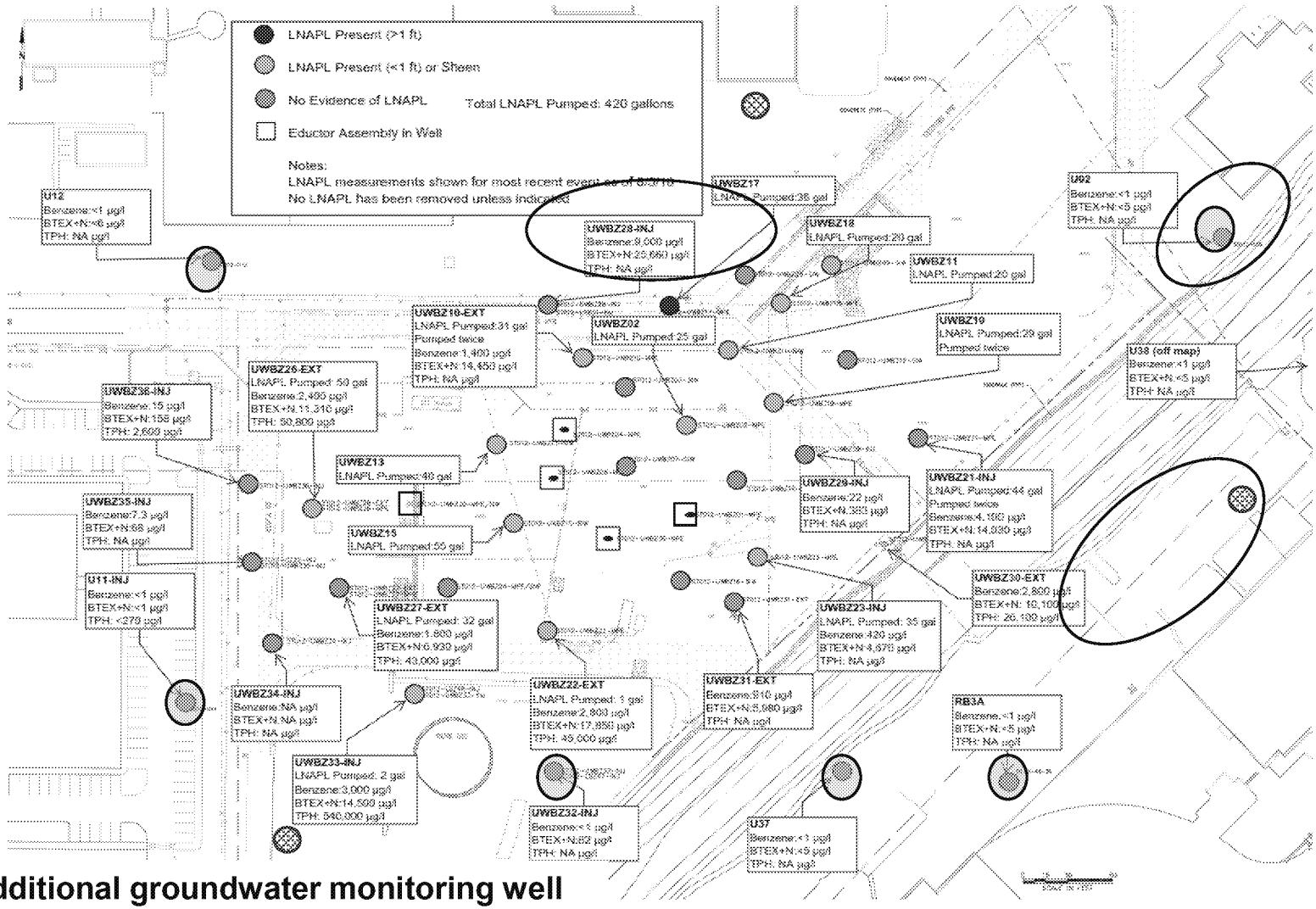
Site ST012 UWBZ Dissolved Phase Concentrations



Site ST012 UWBZ Evaluation of EPA/ADEQ Concerns



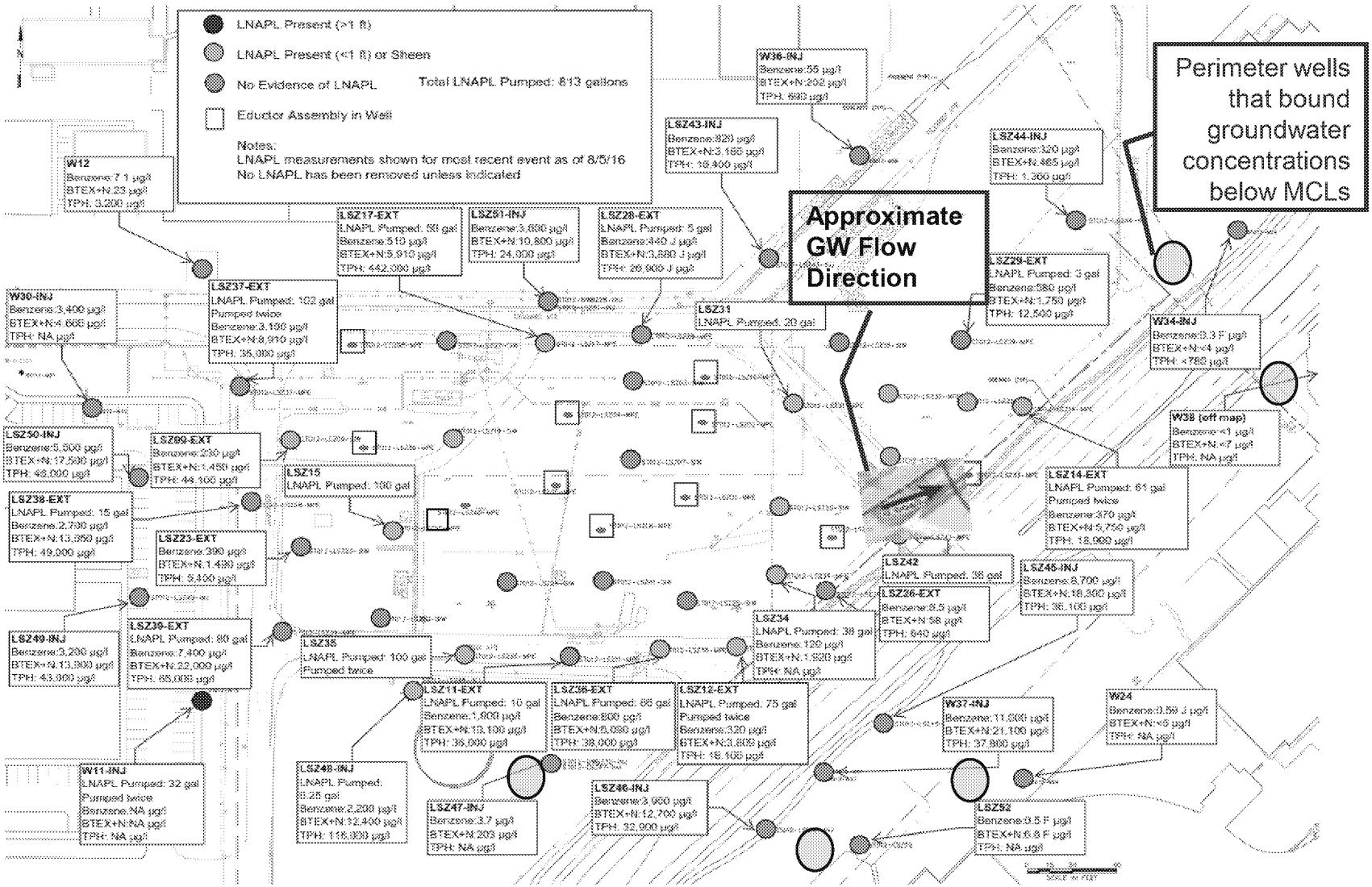
Site ST012 UWBZ Additional Characterization



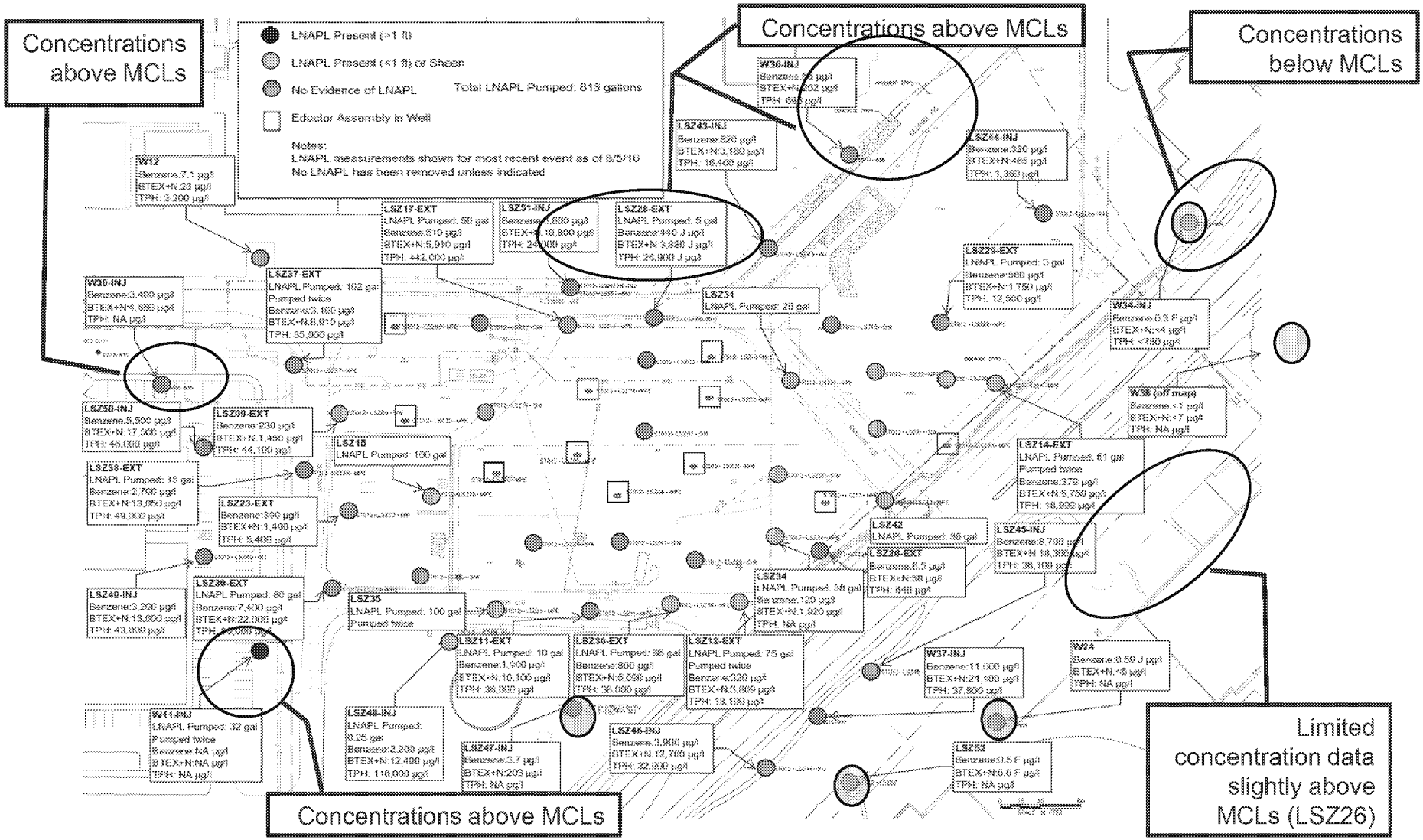
- **Additional groundwater monitoring well**

Area of EPA/ADEQ comment

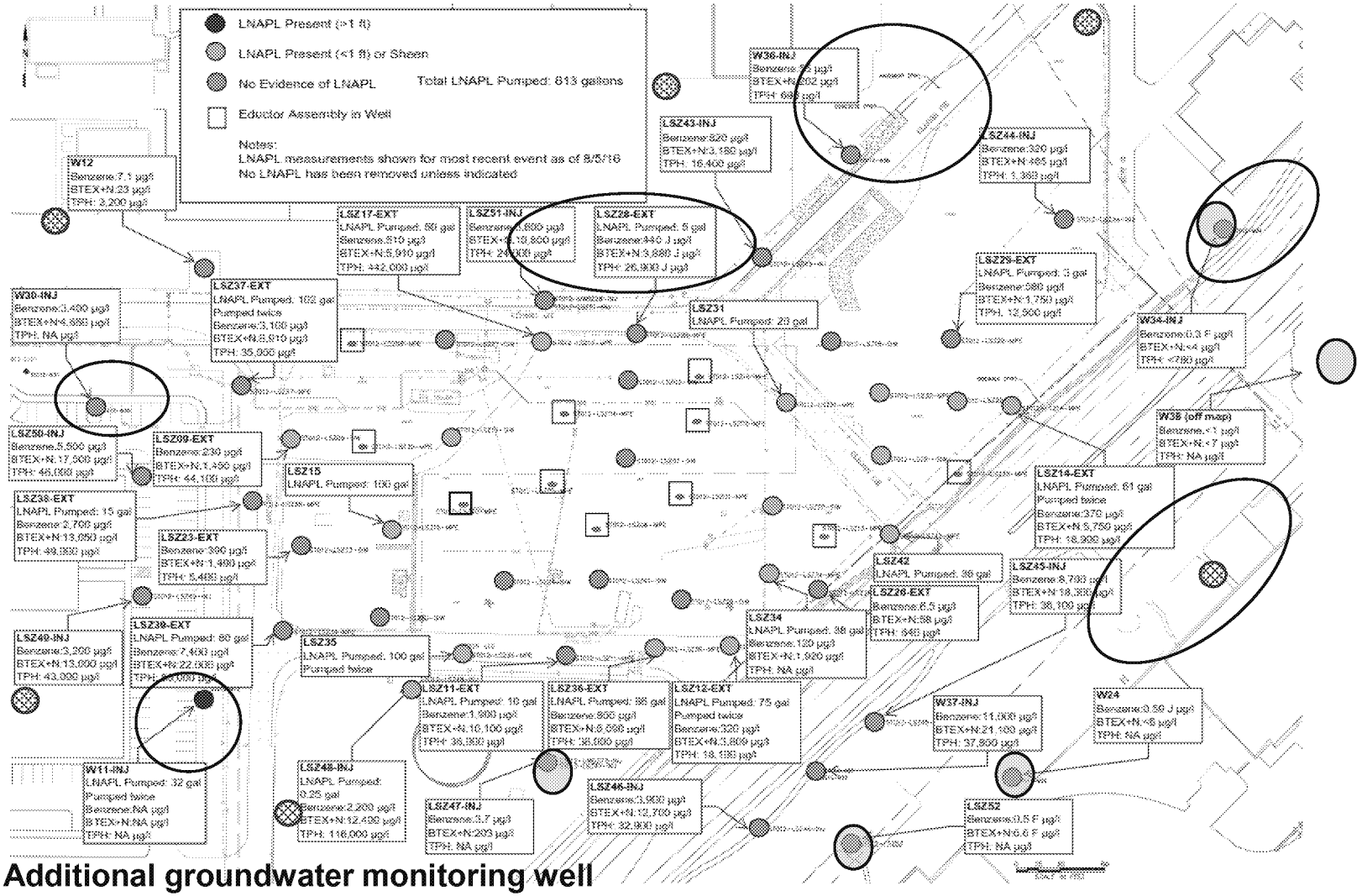
Site ST012 LSZ Dissolved Phase Concentrations



Site ST012 LSZ Evaluation of EPA/ADEQ Concerns



Site ST012 LSZ Additional Characterization

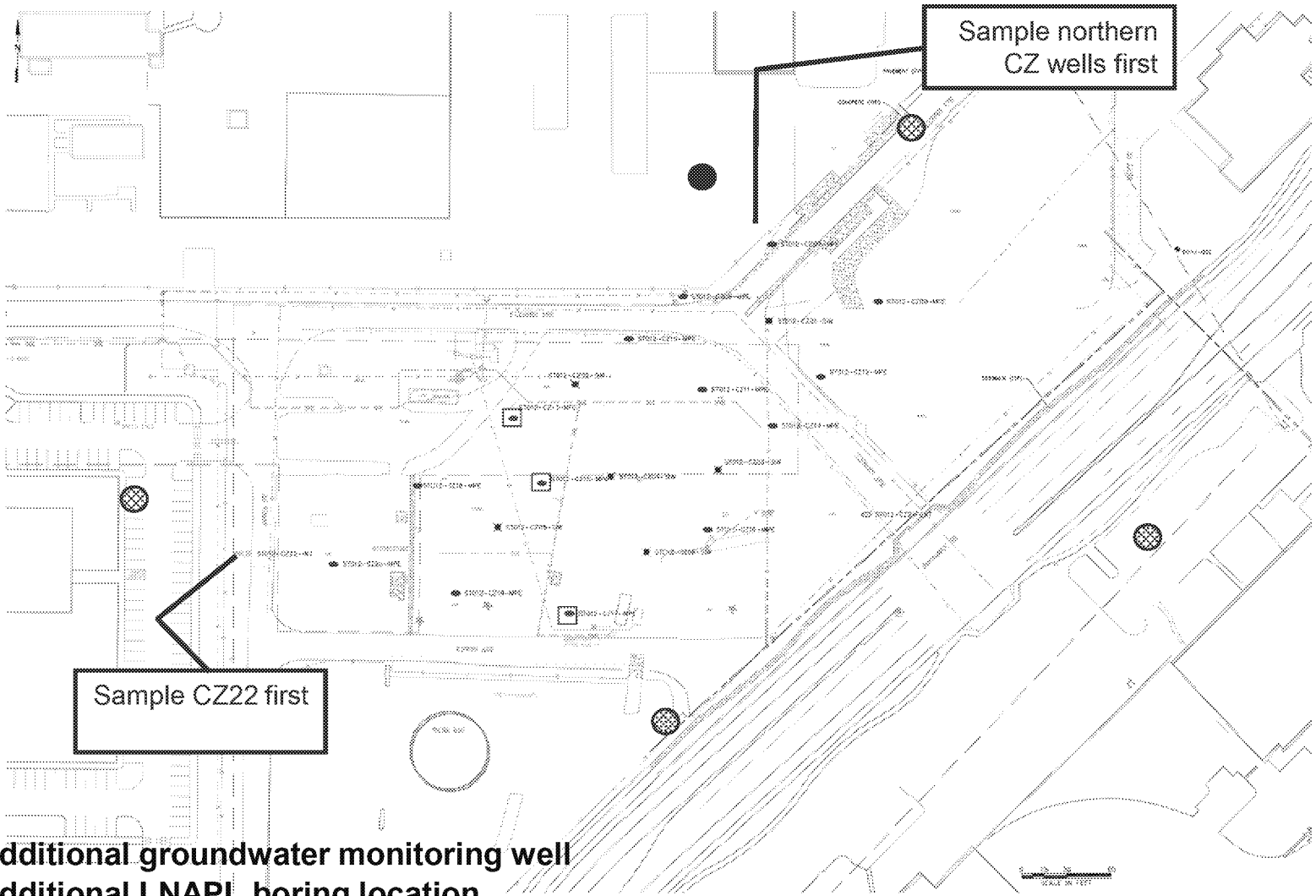


Additional groundwater monitoring well

Area of EPA/ADEQ comment

ST012
Summary of Additional Characterization

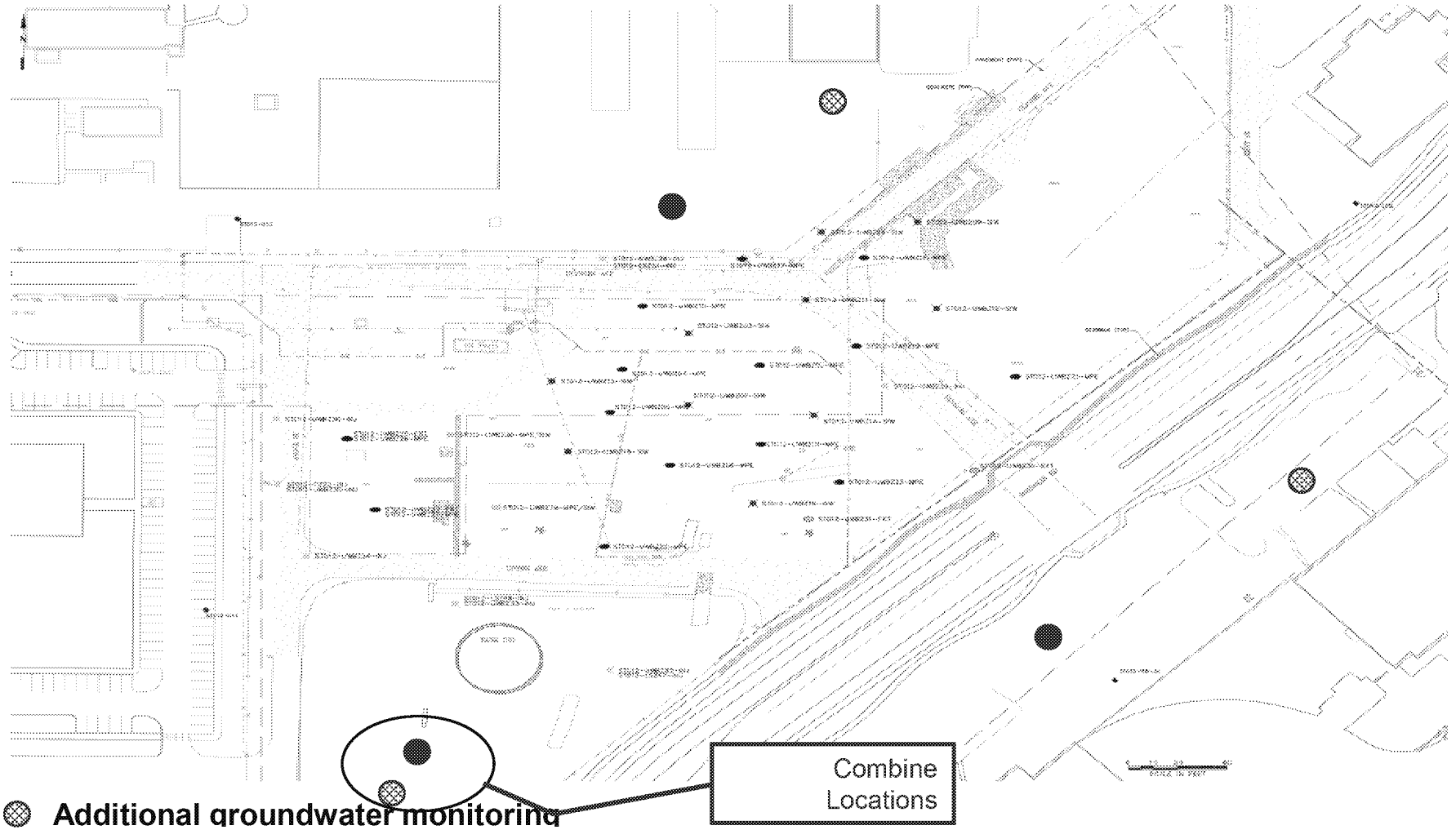
Summary of Additional CZ Characterization



- Additional groundwater monitoring well
- Additional LNAPL boring location

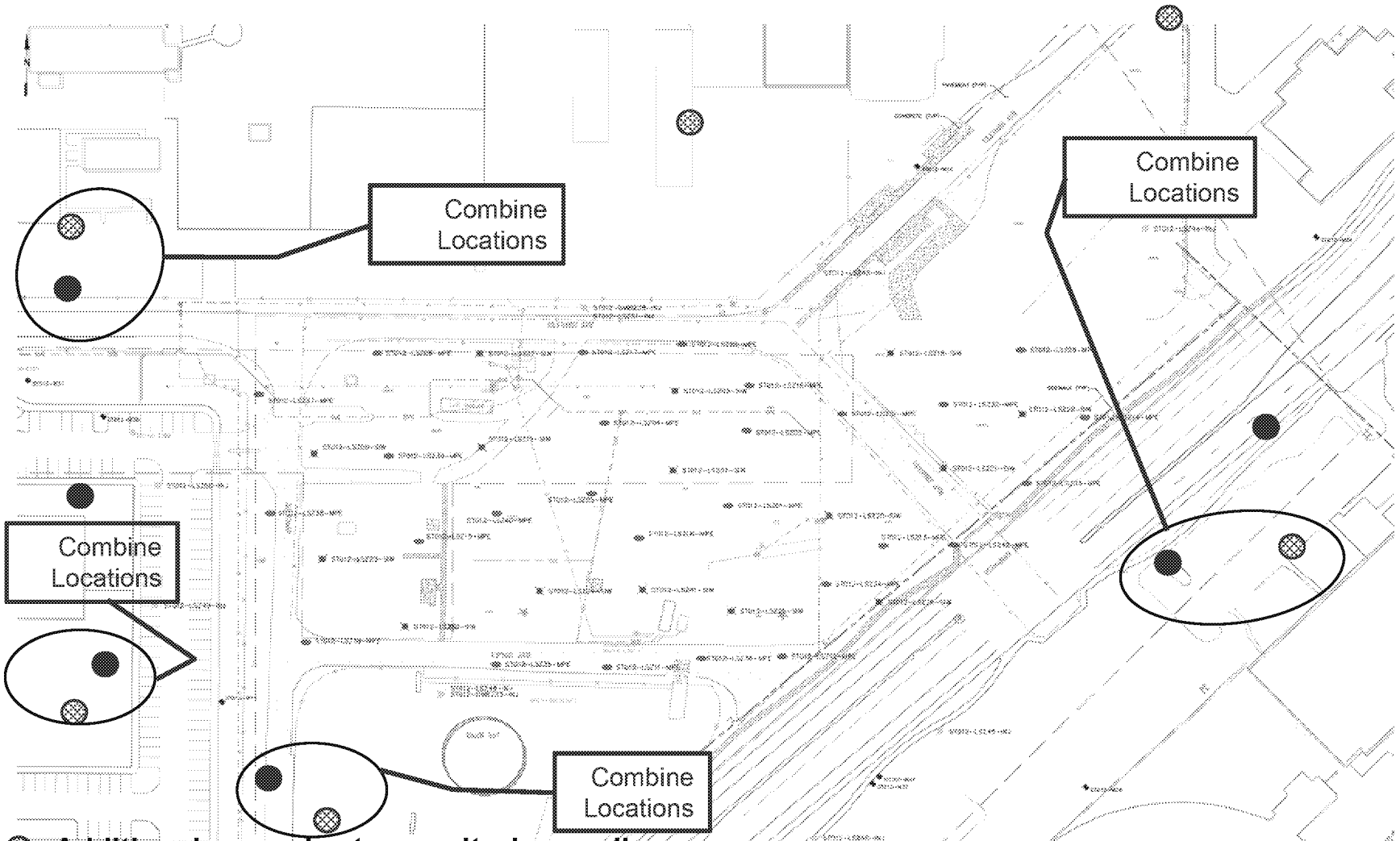
Some locations may also be combined across the vertical intervals (not shown)

Summary of Additional UWBZ Characterization



Some locations may also be combined across the vertical intervals (not shown)

Summary of Additional LSZ Characterization



Some locations may also be combined across the vertical intervals (not shown)

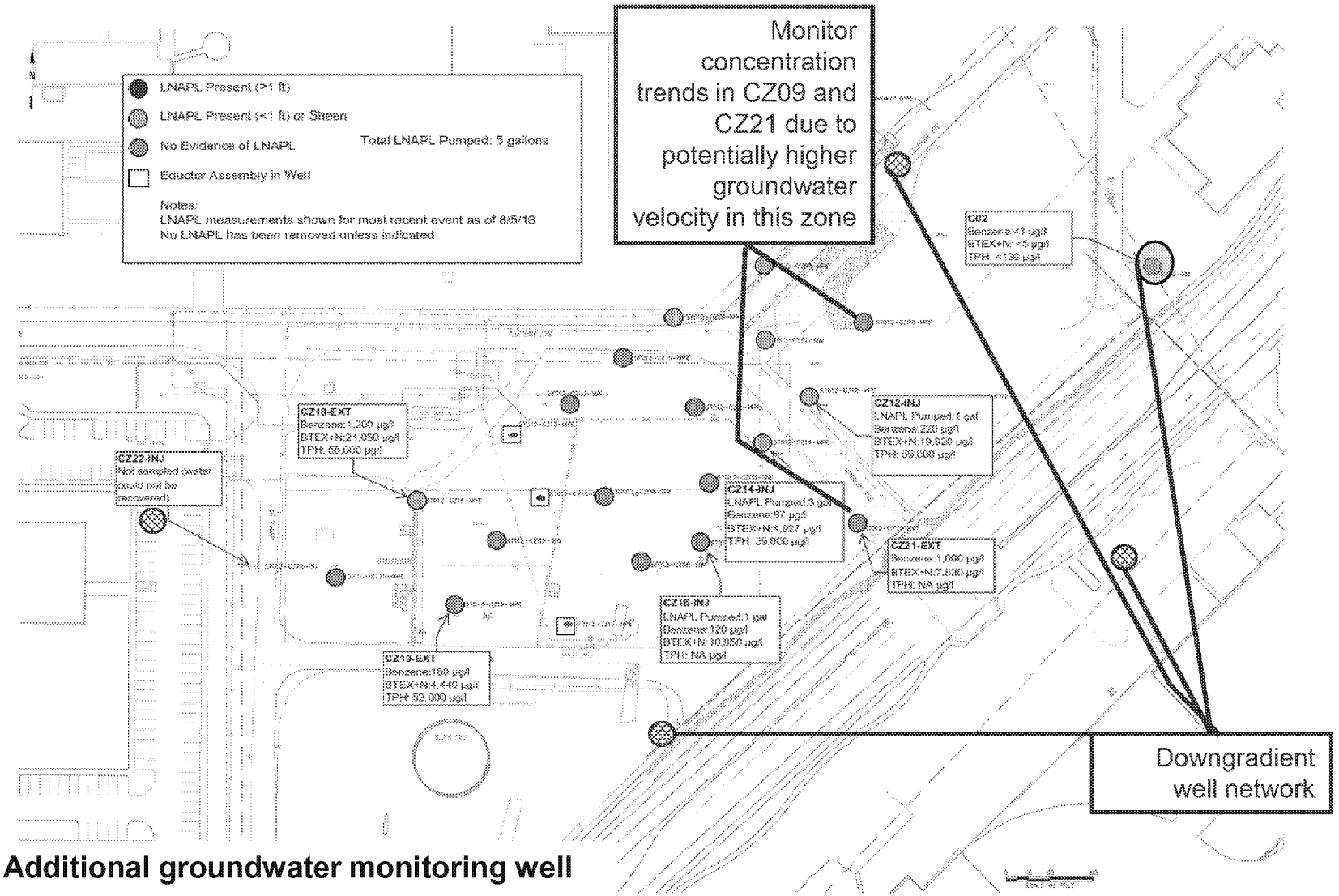
ST012
Containment
Evaluation

ED_005025_00009175-00049

Site ST012 Containment Evaluation

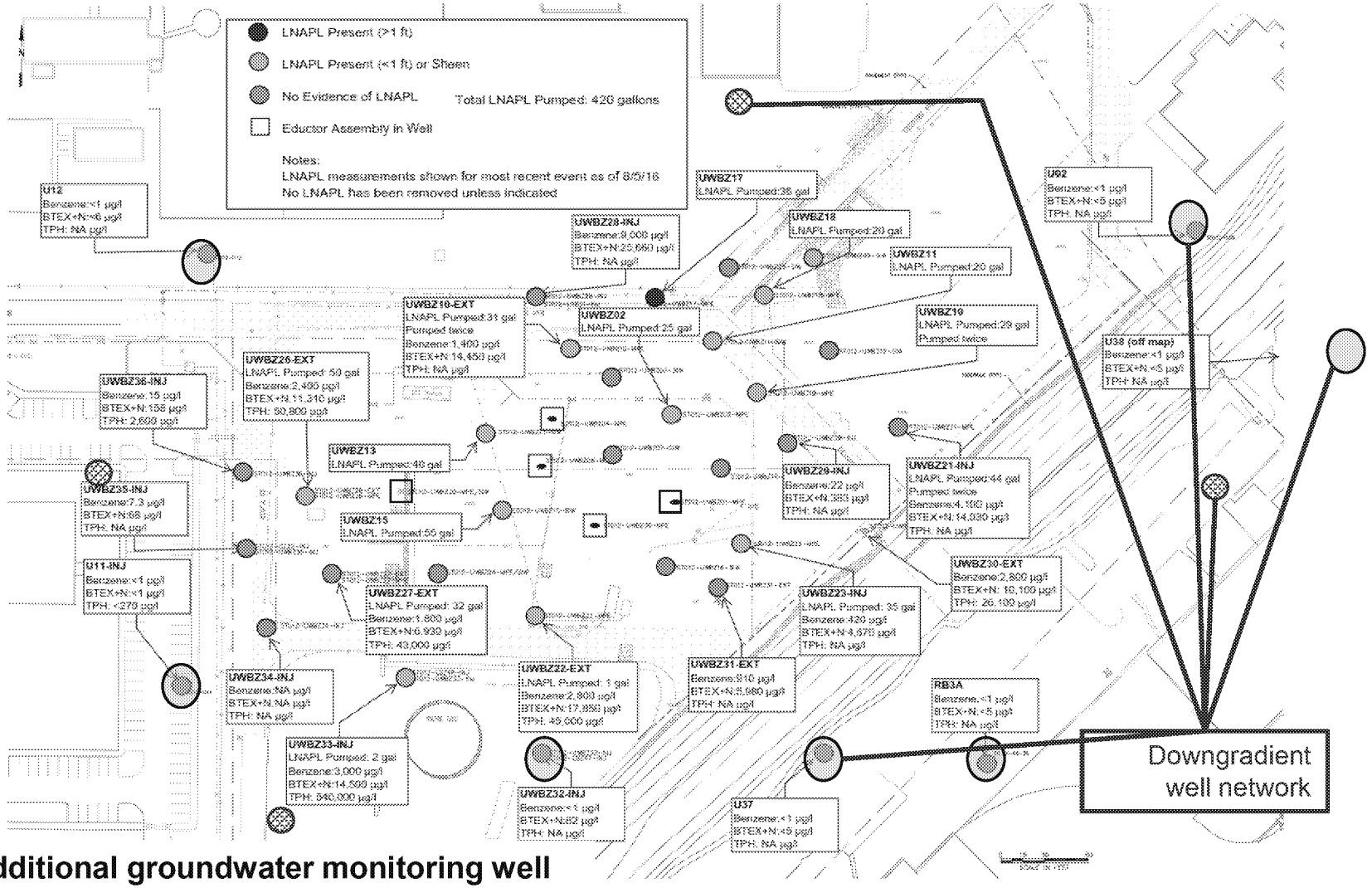
- **Containment**
  - **Containment demonstration using a monitoring well network based on:**
    - **Petroleum plumes typically have limited migration (primarily following initial release)**
    - **The plume has been generally stable for many years**
    - **No evidence of significant migration**
  - **Evaluated monitoring network considering existing plus additional characterization wells**

Site ST012 CZ Containment Monitoring



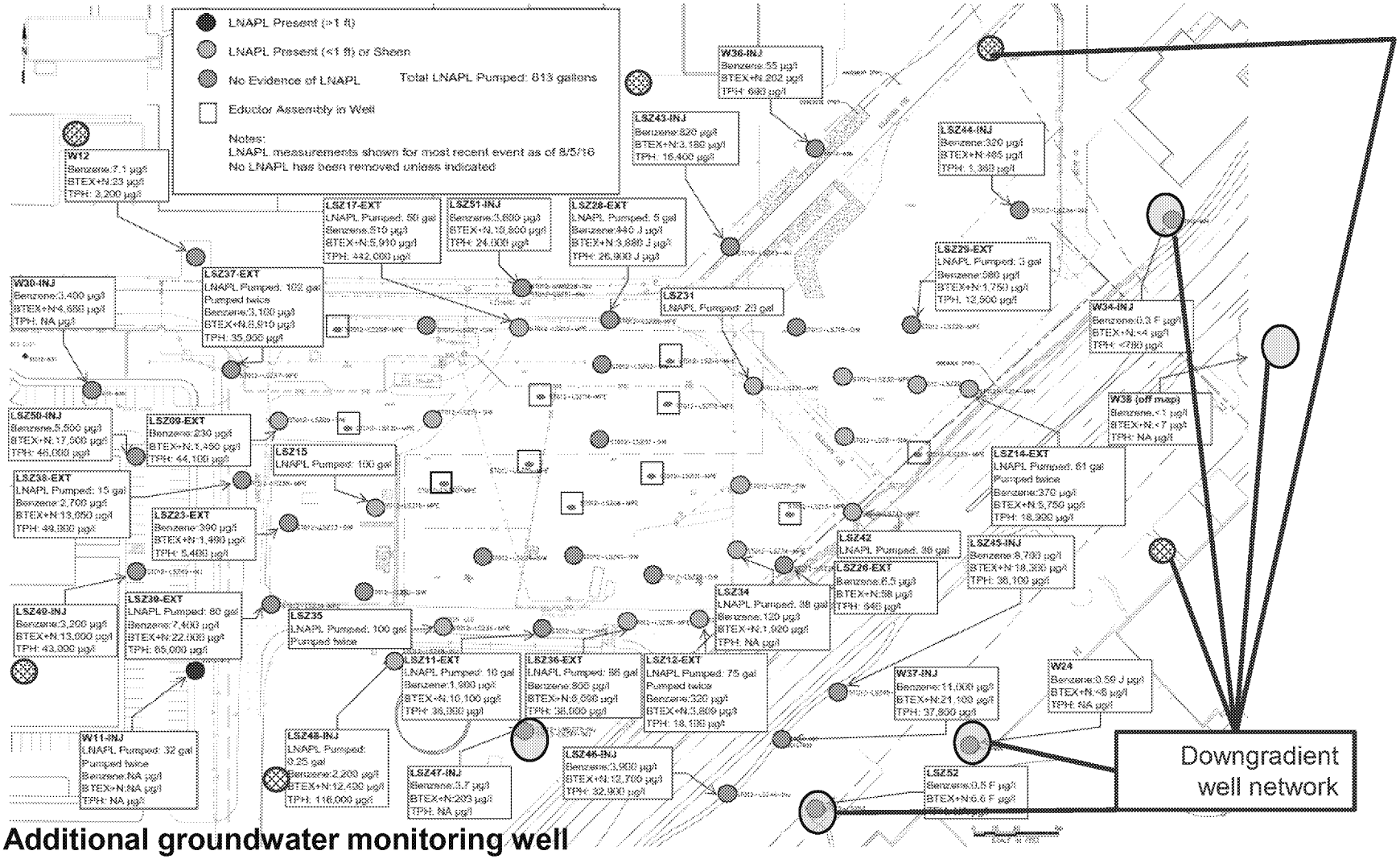
- Additional groundwater monitoring well

Site ST012 UWBZ Containment Monitoring



- Additional groundwater monitoring well

Site ST012 LSZ Containment Monitoring



- Additional groundwater monitoring well

ST012 Path Forward

- Continue SVE operation with flame oxidizer and thermal oxidizer, evaluate connection of additional CZ well(s)
- Continue monitoring/pumping of LNAPL in SEE and perimeter wells
- Proceed with Phase 2 borings and wells under Field Variance Memorandum
- Phase 2 drilling can be started by Sep 19, 2016 if acceptable to EPA/ADEQ
- Obtain and evaluate Phase 2 data for LNAPL and dissolved phase characterization (3 months)
- Construct active containment capability (2 month duration for construction, 100 gpm extraction/treatment system, existing design)

ST012
RD/RAWP
Addendum 2
Response to Comments

Site ST012 RD/RAWP Addendum #2 RTCs

- **Response to Comments submitted to agencies on August 22, 2016**
  - **Mass of LNAPL outside of TTZs**
  - **EBR as a method for source treatment**
  - **Amendment secondary effects (arsenic, sulfate, salinity)**
  - **Injection Permit requirements**

ATTACHMENT 2 EVALUATION OF ADDITIONAL CONCERNS IDENTIFIED DURING THE 24 AUGUST 2016 BCT MEETING

Evaluation of Additional Concerns Identified During August BCT Meeting

Discussion Item	August 24 BCT Meeting Slide	Location of Additional Concern	Basis of Concern	Evaluation	Proposed Resolution
1	14-16	Downgradient of ST012-CZ12 and ST012-CZ14 which have indications of LNAPL	ST012-CZ12 and ST012-CZ14 have had LNAPL in them that has returned following pumping. LNAPL may migrate downgradient.	ST012-CZ12 and ST012-CZ14 are in areas where there were indications of LNAPL prior to SEE. These wells were at the SEE TTZ perimeter. Other pre-SEE borings (see slide 16) through the LSZ indicated that the LNAPL impact did not extend to the northeast (downgradient). The limited volume of LNAPL recovered from ST012-CZ12 and ST012-CZ14 (4 gallons since May) do not indicate a large quantity of LNAPL at risk of mobilization. In addition proposed locations ST012-SB17, ST012-SB18, and ST012-CZ24 provide downgradinet data and monitoring locations.	Continue LNAPL monitoring and removal in ST012-CZ12 and ST012-CZ14. No additional investigation locations unless LNAPL observations in these wells increase in quantity or required frequency of pumping.
2	16	Area north and east of ST012-CZ07	There appears to be a data gap in the extent of LNAPL to the north and east of ST012-CZ07	LNAPL (<0.5 ft) in ST012-CZ07 and ST012-CZ09 has not been pumped since SEE termination and may be a relic of SEE operations. There is a proposed well (ST012-CZ23) for dissolved phase characterization to the north and east of ST012-CZ07 that can be used to bound LNAPL in this area.	Use ST012-CZ23 to bound both LNAPL and dissolved phase extent. Boring will be advanced but well installation will be contingent on confirmation of LNAPL and dissolved phase contamination in northeastern part of CZ TTZ (i.e. ST012-CZ07 and ST012-CZ08).
3	21	Area north and east of ST012-UWBZ09	LNAPL observed in ST012-UWBZ09 indicates a data gap in LNAPL extent to the north and east.	LNAPL in ST012-UWBZ09 has not been pumped since SEE termination and may be a relic of SEE operations. The area was originally outside the extent of LNAPL based on pre-SEE borings. There is a proposed well (ST012-CZ23) for dissolved phase characterization to the north and east of ST012-CZ07 that can be used to bound LNAPL in this area.	Extend ST012-CZ23 boring to bottom of UWBZ to bound LNAPL extent.
4	21	Area to east of UWBZ across Sossaman Rd.	One boring location is proposed for bounding LNAPL; however, the extent of LNAPL on west side of Sossaman could justify two locations	Two soil boring locations were proposed in this area for the LSZ. These two borings will also provide LNAPL characterization at two locations on the east side of Sossaman Rd in the UWBZ.	No new investigation locations added. Proposed LSZ borings (ST012-SB17 and ST012-SB18) will provide adequate coverage.
5	27, 28	Area of ST012-LSZ47	Positive dye test results were obtained from soil collected during drilling of ST012-LSZ47 in the LSZ. Subsequent groundwater samples were below MCLs. Groundwater results should be viewed with caution and the well resampled.	ST012-LSZ47 results are contradictory (positive dye test but low dissolved phase).	ST012-LSZ47 will be resampled. If previous dissolved phase results are confirmed, no additional investigation locations are proposed. Otherwise, an additional soil boring/monitoring well will be discussed (would be ST012-LSZ60).
6	28	Area to north of ST012-LSZ37	ST012-LSZ37 had LNAPL pumped and returned. There is no further bounding location to the north of ST012-LSZ37	ST012-W12, to the north and upgradient, typically has concentrations of COCs slightly above MCLs. ST012-LSZ43 and ST012-LSZ51, to the north and downgradient of ST012-LSZ37 did not have indications of LNAPL. Based on this, significant LNAPL is not likely directly north of ST012-LSZ37, however the extent is not fully defined.	An additional LSZ well has been added to the characterization program (ST012-LSZ59) for LNAPL and dissolved phase characterization.
7	33	Area to northeast of ST012-CZ07 and ST012-CZ09	Proposed well location in this area could be shifted east to line up more downgradient of the CZ wells with observed LNAPL.	Moving the proposed well to the east would make it more downgradient of these CZ wells.	Sample existing northern CZ wells after removing LNAPL to assess conditions. If need for well is confirmed, ST012-CZ23 will be installed. Location of ST012-CZ23 has been adjusted to the east by moving it across the road into the cell phone lot.
8	36	Area between U12 and UWBZ28	There is a gap in existing/proposed well locations for dissolved phase contamination between these wells.	Although ST012-U12 is typically below MCLs, ST012-UWBZ28 had one of the highest benzene concentrations for the baseline sampling.	An additional UWBZ well has been added to the characterization program (ST012-UWBZ40) for dissolved phase characterization.
9	39	Area between the two proposed wells on the north	There is a gap in existing/proposed well locations for dissolved phase contamination, especially the area north of ST012-LSZ17, ST012-LSZ37, and ST012-LSZ51	Although ST012-W12 is typically close to MCLs, ST012-LSZ17 and ST012-37 have had recurring LNAPL after pumping and dissolved phase concentrations are well above MCLs.	An additional LSZ well has been added to the characterization program (ST012-LSZ59) for LNAPL and dissolved phase characterization.

Notes:
BCT - BRAC Cleanup Team
BRAC - Base Realignment and Closure
CZ - cobble zone
LNAPL - light non-aqueous phase liquids
LSZ - lower saturated zone
MCLs - maximum contaminant levels
SEE - steam enhanced extraction
TTZ - thermal treatment zone
UWBZ - upper water bearing zone

ATTACHMENT 3 PROPOSED SOIL BORING AND MONITORING WELL LOCATIONS

Legend

Proposed Characterization Investigation

- Upper Water-Bearing Zone Groundwater Monitoring Well Location
- Cobble Zone Groundwater Monitoring Well Location
- Lower Saturated Zone Groundwater Monitoring Well Location
- Soil Boring Location
- EBR Well Location
- Fence Line
- ST012 Site Boundary

Notes:

* Installation of well is contingent on additional sampling. See Drilling Plan table for details.

ST012-LSZ45 Well Identification

EBR Enhanced Bioremediation

0 25 50 100 Feet

N

Site ST012 - Former Williams Air Force Base
Mesa, Arizona

Proposed Characterization Investigation Locations

FIGURE		
1	Job No.:	9101110001
	PM:	DS
	Date:	9/13/2016
	Scale:	1" = 100'

The map shown here has been created with all due and reasonable care and is strictly for use with Amec Foster Wheeler Project Number 9101110001. This map has not been certified by a licensed land surveyor, and any third party use of this map comes without warranties of any kind. Amec Foster Wheeler assumes no liability, direct or indirect, whatsoever for any such third party or unintended use.

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ATTACHMENT 4 SOIL BORING AND MONITORING WELL LOCATIONS AND DRILLING PLAN

Locations and Drilling Plan

Drilling Order	Designation	Purpose		Drilling Plan		
		LNAPL Extent	Dissolved Extent	Evaluation/Rationale	During Drilling	After Sampling
1	ST012-UWBZ37[a]		x	Data gap in bounding of dissolved phase north of ST012-UWBZ17 (see BCT slide 36)	Step out in future if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
	ST012-LSZ53[a]		x	Data gap in bounding of dissolved phase north of ST012-LSZ17 and ST012-LSZ28 (see BCT slide 39)	Step out in future if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
2	ST012-SB16[b]	x (CZ, UWBZ)		Data gap in bounding of LNAPL extent north of ST012-CZ07 and CZ08 (see BCT slide 16) and north of ST012-UWBZ17 and ST012-UWBZ28 (see BCT slide 21)	Step out in future phase if LNAPL indications[f]	
3	ST012-SB17	x (UWBZ, LSZ)		Data gap in bounding of LNAPL extent east of Sossaman Road in the LSZ (see BCT slide 28). UWBZ added per BCT comment (see Discussion Item 4 in Attachment 2)	Step out in future phase if LNAPL indications[f]	
4	ST012-SB18	x (UWBZ, LSZ)		Data gap in bounding of LNAPL extent east of Sossaman Road in the UWBZ and LSZ (see BCT slides 21 and 28)	Step out in future phase if LNAPL indications[f]	
5	ST012-SB19	x (LSZ)		Data gap in bounding of LNAPL extent west of ST012-LSZ50 and southwest of ST012-W30 (see BCT slide 28)	Step out if LNAPL indications[f]	
6	ST012-UWBZ39	x (UWBZ)	x	Data gap in bounding of LNAPL extent and dissolved phase southwest of ST012-UWBZ33 (see BCT slides 21 and 36)	Step out in future if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
7	ST012-LSZ58	x (LSZ)	x	Data gap in bounding of LNAPL extent and dissolved phase north of ST012-W30 (see BCT slides 28 and 39)	Step out in future if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
8	ST012-LSZ56	x (LSZ)	x	Data gap in bounding of LNAPL extent and dissolved phase west of ST012-W11 (see BCT slides 28 and 39)	Step out if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
9	ST012-LSZ57	x (LSZ)	x	Data gap in bounding of LNAPL extent and dissolved phase south of ST012-W11 (see BCT slides 28 and 39)	Step out if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
10	ST012-LSZ60[c]	x (LSZ)	x	Potential data gap in bounding of LNAPL extent and dissolved phase south of ST012-LSZ47 per BCT comment (see discussion item 5 in Attachment 2)	Step out in future if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
11	ST012-UWBZ40[a]	x (UWBZ)	x	Potential data gap in bounding of LNAPL extent and dissolved phase northwest of ST012-UWBZ28 per BCT comment (see discussion item 8 in Attachment 2)	Step out in future if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
	ST012-LSZ59[a]	x (LSZ)	x	Potential data gap in bounding of LNAPL extent and dissolved phase north of ST012-LSZ37 and ST012-LSZ51 per BCT comment (see discussion items 6 and 9 in Attachment 2)	Step out in future if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
12	ST012-LSZ54		x	Data gap in bounding of dissolved phase northeast of ST012-W36 (see BCT slide 39)	Step out in future if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
13	ST012-CZ24[a]		x	Data gap in bounding of dissolved phase east of ST012-CZ21 (see BCT slide 33)	Step out in future if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
	ST012-UWBZ38[a]		x	Data gap in bounding of dissolved phase east of ST012-UWBZ21 and ST012-UWBZ30 (between ST012-U38 and ST012-RB3A (see BCT slide 36)	Step out in future if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
	ST012-LSZ55[a]		x	Data gap in bounding of dissolved phase east of ST012-LSZ14 and ST012-LSZ42 (between ST012-W38 and ST012-W24 (see BCT slide 39)	Step out in future if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
14	ST012-CZ25		x	Data gap in bounding of dissolved phase east of ST012-CZ21 (see BCT slide 33)	Step out if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
15	ST012-CZ26[d]		x	Potential data gap in bounding of dissolved phase west of ST012-CZ22 (see BCT slide 33)	Step out if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]
16	ST012-CZ23[e]	x (UWBZ)	x		Step out in future if LNAPL indications[f] or high PID readings[g]	Potentially step out in future if > MCLs[h]

Notes:

1. Borings and wells will be advanced with sonic methods and the continuous geology logged. PID readings will taken at least every 5 feet or in areas of noted odors or staining.
2. Dye test kits will be conducted on soil samples suspected of containing LNAPL. At a minimum any zones with PID readings > 250ppmv will require a dye test kit.

[a]Potential nested well location. If installed as adjacent wells, the deepest location will be installed first and logged. Adjacent shallower wells will not be logged and may use alternate drilling methodology (e.g., air rotary).

[b]Boring will only be installed if characterization at in ST012-UWBZ37 and/or ST012-LSZ53 area confirms LNAPL is not present at those locations.

[c]Boring/well will only be installed if additional sample collected from ST012-LSZ47 indicate concentrations above MCLs. If concentrations are slightly above MCLs, the need for the well will be discussed with the AF and regulators.

[d]Well will only be installed if additional sample collected from ST012-CZ22 indicate concentrations above MCLs. If concentrations are slightly above MCLs, the need for the well will be discussed with the AF and regulators.

[e]Boring will be advanced through the UWBZ. A well will only be installed for the CZ if samples collected from ST012-CZ07 and ST012-CZ08 indicate concentrations above MCLs. If concentrations are slightly above MCLs, the need for the well will be discussed with the AF and regulators. No well is planned for the UWBZ.

[f]Dye test kits will be run if PID screening results are >250 ppmv. If dye test kit results are pink or red, location has indications of LNAPL. Drilling will continue until negative dye test achieved. Drilling will continue below that only if there is a deeper zone to be investigated for LNAPL at this location. If positive indicatior of LNAPL at any depth, discuss additional step out location with AF and regulators. Step out in tank farm and army reserve center may be possible under the same mobilization. Step out east of Sossaman Road and north of Ulysses Ave. will require a future mobilization to allow time to coordinate with property owners

[g]If PID screening results are >15 ppmv in the planned screened interval, location may not bound dissolved phase contamination. Drilling will continue until PID readings return to background. Discuss grouting of the boring (not installing well) and additional step out location for a well with AF and regulators. If high PIC readings are in a clay layer, potentially complete the well.

[h]An additional step-out well will be discussed with the AF and regulators if concentrations are slightly above MCLs.

AF - Air Force
CZ - cobble zone
LNAPL - light non-aqueous phase liquids
LSZ - lower saturated zone
MCLs - maximum contaminant levels
PID - photoionization detector
ppmv - parts per million by volume
UWBZ - upper water bearing zone